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THE BOTANICAL GAZETTE

EDITORS:

JOHN M. COULTER, University of Indiana, Bloomington, Ind.
CHARLES R. BARNES, University of Wisconsin, Madison, Wis.
J. C. ARTHUR, Purdue University, Lafayette, Ind.

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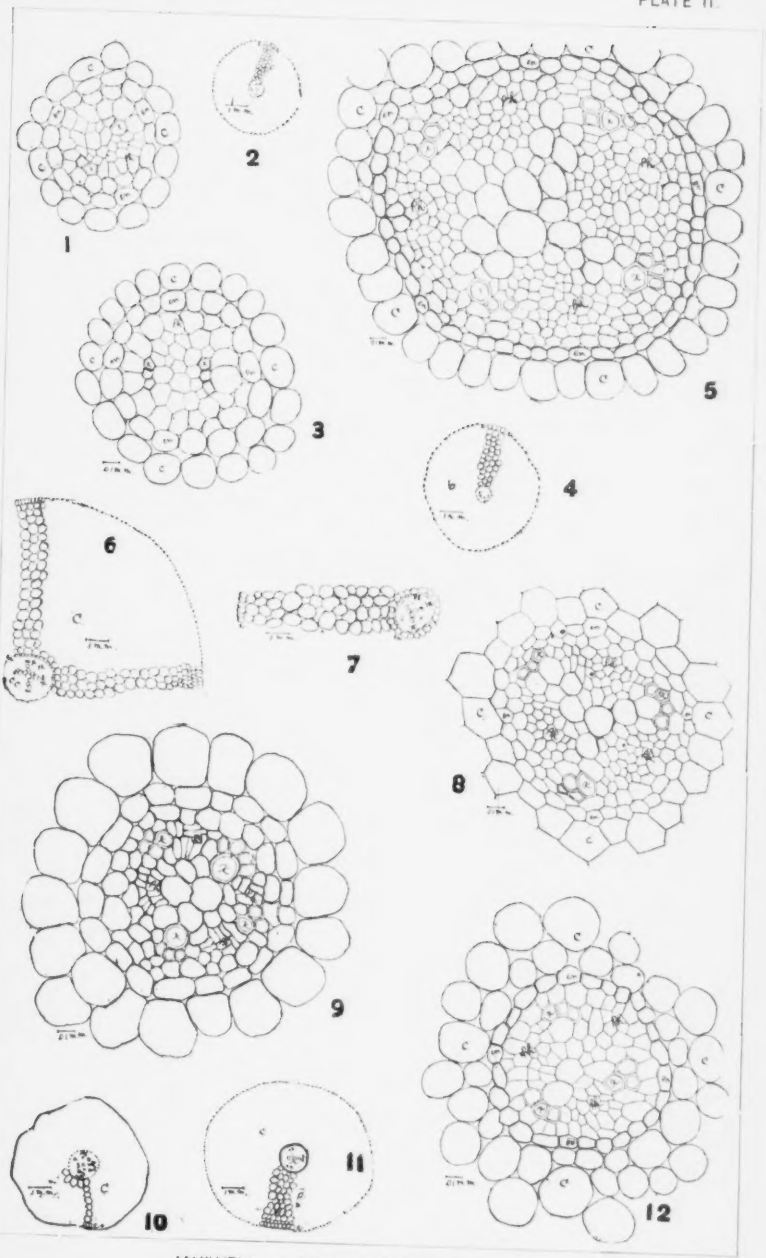
In the March number will appear:

On Monilia fructigena, by JAMES ELLIS HUMPHREY, *Weymouth Heights, Mass.*

Non-parasitic bacteria in vegetable tissue, by DR. H. L. RUSSELL, *University of Chicago.*

Note on Phallogaster saccatus, by DR. ROLAND THAXTER, *Harvard University.*

Also the concluding part of DR. MAXWELL'S *paper on the* **Roots of Ranunculaceæ.**



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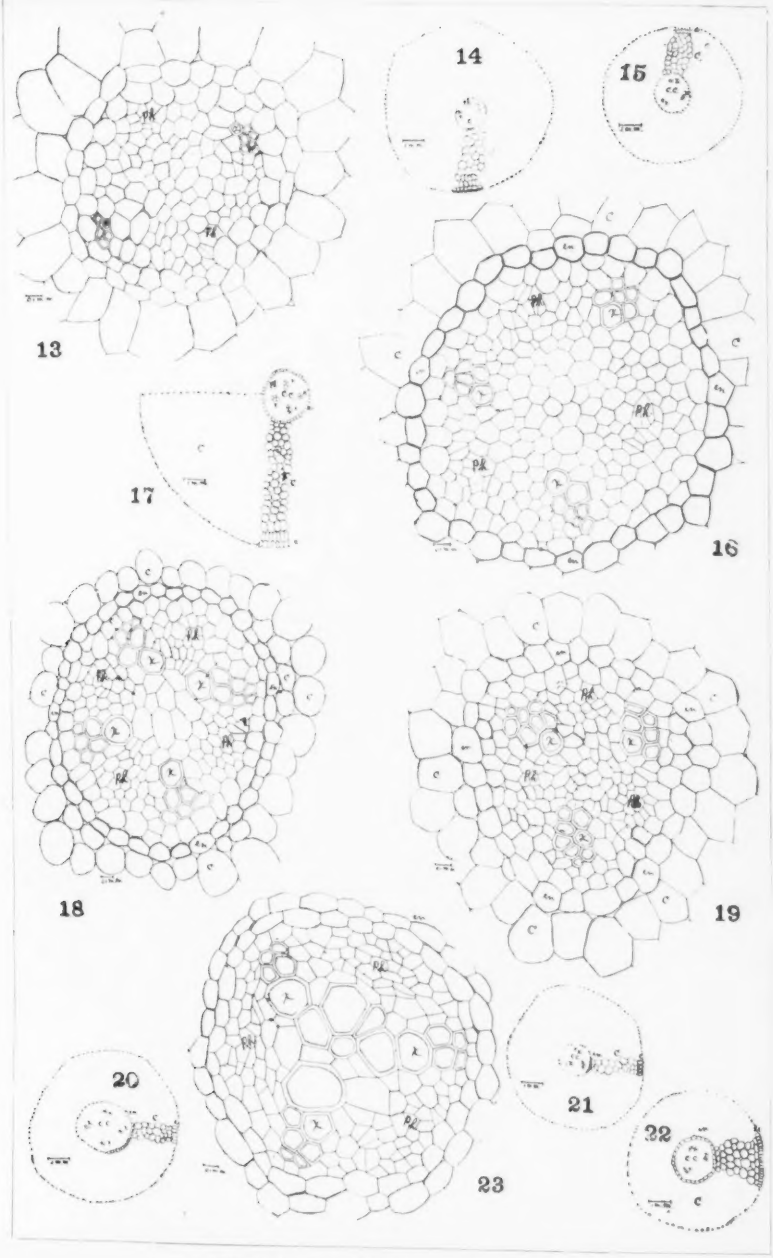

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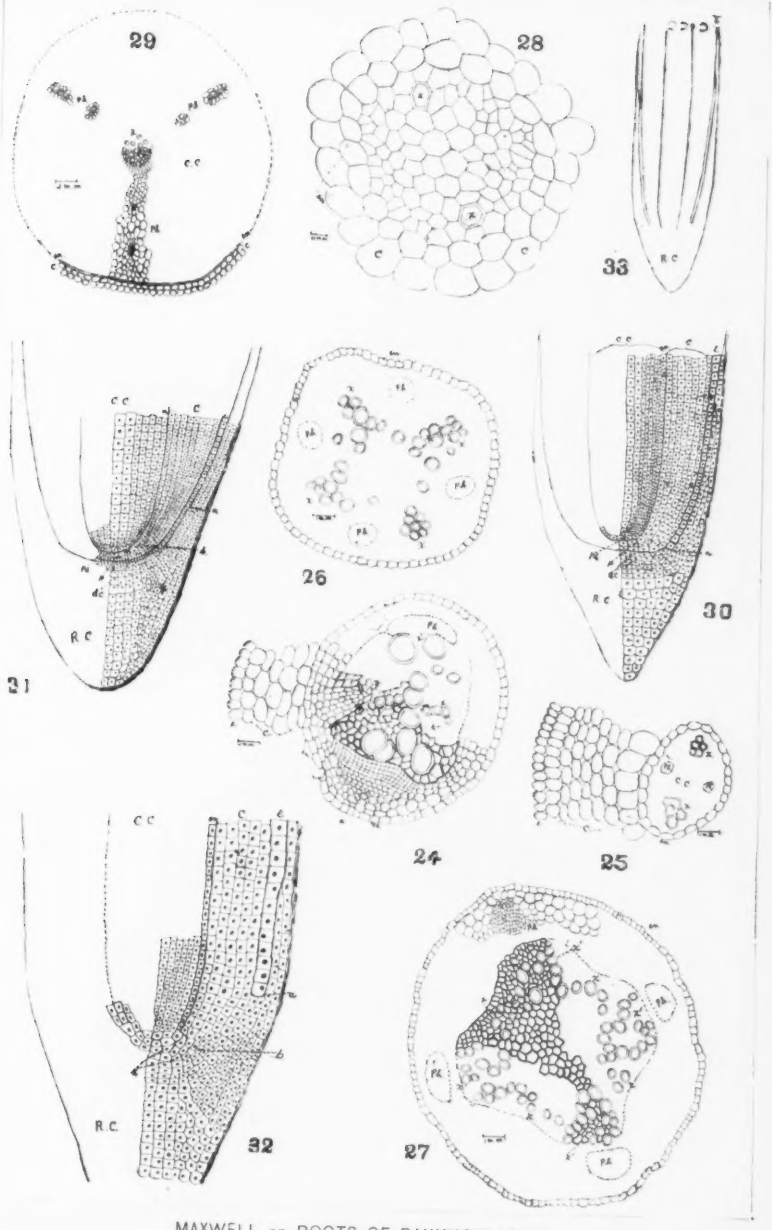

MAXWELL on ROOTS OF RANUNCULACEÆ.

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BOTANICAL GAZETTE

FEBRUARY, 1893.

A comparative study of the roots of Ranunculaceæ.

FRED. B. MAXWELL.

WITH PLATES II—IV.

(Continued from p. 16.)

II. Methods of investigation.

I began collecting material for this work in August, 1891, and continued collecting until the ground became frozen in the fall. The roots of Ranunculaceæ being generally fibrous, and often very long and slender, it was no easy matter to obtain material that would answer my purpose, as in all cases I desired perfect root tips for the study of the meristem, besides pieces of the root from several points in its length for the comparative study of the general structure. Of many of the species I obtained plants which were potted and after getting them started in a cold frame they were placed in the green house, and when more material was needed I had but to take the plant from the pot, disturbing it as little as possible, and then repot it to keep for farther use. My best sections were obtained in this way, for after the plants became thoroughly established the root tips were abundant and there was not the danger of injuring them in collecting which necessarily attends out-door collection of such material. Another advantage from this method was that they were always ready at hand when more material was needed to corroborate some point. The material was all dehydrated and hardened in alcohol, a Thomas dehydrating apparatus being used. It was then prepared according to the collodion method, in all cases serial longitudinal sections of the root tip being made for the study of the meristem. Over three hundred slides were prepared, about two hundred of which furnished the material for my study. The roots of some of the plants were so small that the making of good sections was a difficult task. Among such roots are those of *Anemone Caroliniana*, *Coptis*

trifolia, and *Anemonella thalictroides*. Many of these roots which were sectioned were less than .5^{mm} in diameter. Sectioning such roots met with many failures, especially in getting good longisections of the tip. One series of transections of a root the diameter of which could not have been over .25^{mm} was obtained, which showed the bundle structure fairly well. Careful camera lucida drawings were made of the transections of most of the roots, and these with the sections of the roots themselves were studied in making my comparisons. All of these drawings could not be embodied in this thesis, but many of them will be found on the plates. In the study of the meristem structure rough drawings were made of most of the tips, then comparisons were made, and but one detailed drawing was made for each type of structure.

III. General structure.

As to the general histological structure, especially as to the difference between old and young roots, I should make two general classes of the plants of Ranunculaceæ, first, those not showing decided secondary change in older roots, and second, those presenting certain modifications from the primary structure in the older roots; in the second class there are two different modifications of the primary structure, thus making three classes.

The first class includes those plants in which the original radial structure persists in the older roots, that is secondary growth produces but little change in the plan of root structure. The cortex may become less compact by the disappearance of cells, and the xylem may increase in the number of its rays, and its vessels in the number and thickness of their walls, but the primary radial structure is still evident. As especially good representatives of this class I would name the roots of *Ranunculus septentrionalis* and *Ranunculus acris*. In these the smallest branches and the largest main roots showed exactly the same type of structure. This plan for *R. acris* is shown in plate II, figs. 5 and 6. In both of these plants the oldest roots showed in the bundle area simply an increase in the number of the xylem vessels, and in the cortex irregular air spaces occurred through the disappearance of cells in certain areas or the tearing apart of the cells through rapid growth, but the plan of structure was still the same as in the younger roots, this being a triad or tetrad radial bundle. In

this class I would also include *Hepatica acutiloba*,[1] *H. triloba*, *Aconitum Noveboracense*,[2] *Trollius laxus*, *Caltha palustris*,[3] *Ranunculus recurvatus*, *R. Pennsylvanicus*, *R. fascicularis*,[5] *R. circinatus*,[6] *R. aquatilis* var. *trichophyllus*,[7] *R. bulbosus*, *R. multifidus*,[8] *R. septentrionalis*, and *R. hispidus* Michx.,[9] a form not recognized as a distinct species in Gray's Manual, but it is certainly a very distinct type and I believe is recognized as a species by many botanists, though others regard it as a variety of *R. fascicularis* or *R. septentrionalis*. In root structure it is more like the latter. In all of these species which I could get to study, the roots, both young and old, large and small, had the characteristic radial type of root structure. In certain cases it might be that at another time of the year the roots would have presented a different structure, though as most of my material was collected in the fall the larger roots collected then ought to have shown it, if there was to be a change through secondary growth.

The second class on this basis would include those plants in which, by the growth of secondary xylem rays between the primary ones and in front of the phloem masses (these secondary rays often becoming more prominent than the primary ones), the radial character of the young root is lost and the bundle appears like a collateral one with the xylem collected in the center and the phloem in separated groups answering to the original number of the xylem rays, and lying entirely without the xylem mass. Along with the change in the bundle area the endodermis generally undergoes a change. Through division the cells become much smaller and often nearly square in form; and the whole central cylinder becomes larger in proportion to the diameter of the root, partly through increase in bundle elements and partly through increase of conjunctive parenchyma. On the other hand many of the roots of the first class show a smaller central cylinder in the older roots, the increase principally having taken place in the cortex.

As a good example of this second class of roots, I will des-

[1] Plate III, figs. 13, 14.
[2] Plate IV, figs. 22, 23.
[3] Plate III, figs. 17, 18.
[5] Plate II, figs. 9, 10.
[6] Plate II, figs. 3, 4.
[7] Plate II, figs. 1, 2.
[8] Plate II, figs. 11, 12.
[9] Plate II, figs. 7, 8.

cribe the two forms of structure as found in the young and old roots of *Clematis Virginiana.*[10] In the young root (fig. 25) the are as marked *x* are the primary xylem rays and *ph* the phloem masses, the cells of which are not drawn, the endodermis is seen at *en*, the cortex at *c*, and the epidermis at *e*.

The structure of the older roots is represented in fig. 24 in which the original xylem rays are at *x*, and secondary xylem rays, *x'*, have been developed so as to be more prominent than the original rays, and have pushed the phloem, *ph*, toward the endodermis; at *a* is what appears to be meristematic tissue, peripherad of which are the phloem cells. All within the dotted line is of thick walled cells, probably a part of the secondary xylem. The endodermis has become somewhat modified though not as much so as in many of the roots of this class, but the central cylinder is notably larger in proportion than in the smaller roots, as the figures well show.

About the same change in structure between the old and young roots is shown in plate IV, figs. 26 and 27, which were drawn from sections of the roots of *Cimicifuga racemosa.* Here the primary xylem and phloem have a tetrad arrangement, but practically the same secondary change has taken place in the older roots and as the lettering is the same the figures will need no explanation. In this class also belong *Anemone Virginiana*[11] and its var. *alba*, *A. Pennsylvanica*, *Actæa alba*,[12] *A. spicata* var. *rubra*, *Clematis verticillaris*, *Coptis trifolia*, *Hydrastis Canadensis*, and *Ranunculus sceleratus.* The structure of the younger roots of *Anemone Virginiana* and its var. *alba*, and of both species of *Actæa* are found represented in the figures. In all, the secondary changes are very similar to those already described, and need no detailed description. The only singular thing about this class is that we find *Ranunculus sceleratus* here, for it is the only *Ranunculus* that shows marked secondary change. As it is reckoned by Dr. Gray as an annual, we should hardly expect a change to occur here, while the roots of *Ranunculus acris*, which is certainly a perennial, do not show secondary change.

I should make a third class of structure for *Thalictrum dioicum*, *Thalictrum polygamum*, *Anemonella thalictroides*, and *Aquilegia Canadensis*, for the larger roots of these plants

[10] Plate IV, figs. 24, 25.
[11] Plate III, figs. 15, 16.
[12] Plate III, figs. 19, 21.

present a very peculiar structure, as compared with the structure of the roots of the other plants of the order. I will endeavor to make this clear by describing the structure of the older roots of *Thalictrum dioicum.*[13] The smaller, younger roots of all of these plants show the usual radial root structure, and do not deserve particular description. This plant, and especially *Thalictrum polygamum*, has a numerous cluster of large fibrous roots, and it is the structure of these roots that will be described. A cross section of these roots shows a very large central cylinder enclosed by a very regular endodermis composed of very small square cells. The xylem vessels are in a rather compact cluster at the center, and radiating from this are from two to four rays of phloem, each ray of two or more separated groups, the cells of which are very small and thin walled. Sometimes the central xylem presents the same number of short rays as the phloem The greater mass of the central cylinder is occupied by very regular and generally angular cells, the walls of which are often slightly thickened. The cortex is very small in proportion to the central cylinder and is of roundish loosely packed cells. At first an epidermis is present, but most of these roots gathered in the fall had exfoliated their epidermis together with all but about two rows of very loosely packed cortex cells. This leaves the endodermis as the real protecting organ, and perhaps accounts for its rather peculiar appearance. The walls of the endodermal cells are generally cutinized.

The structure of a younger root of *T. polygamum* is shown in plate III, fig. 20 and plate IV, fig. 28. The style of structure which has been described for the older roots of *T. dioicum* was also observed in the older roots of *T. polygamum* and *Aquilegia Canadensis*, and in the tuber-like roots of *Anemonella thalictroides*, though with minor differences in each case. I have not examined the roots of *Isopyrum biternatum*, but from Prof. Hargitt's description I should say it too belonged in this class.

From the above descriptions it will be seen that Olivier's statements concerning the genus *Ranunculus* are borne out by my observations, for in only one species, *Ranunculus sceleratus*, could I discover any great change of structure through secondary development. The exfoliation of the cortex of the Thalictrums is spoken of by both Olivier and Ma-

[13] Plate IV, fig. 29.

rie, though I had made out these facts for myself before knowing what their statements were. Marie also refers to the two forms of structure as found in roots like those of *Actæa alba*.

IV. Miscellaneous considerations.

Treub, among others, proposed to use anatomical characters to aid in the classification of plants, using root characters as well as those of the stem and leaf. Erickson in discussing this idea said that he did not think this could be accomplished, for his study showed him that very nearly related plants showed very different histological structures, and that in many roots which he studied he could not tell the one from the other. From my study of the roots of the *Ranunculaceæ* I should say that anatomical characters, especially root characters, could only be used in a very general way, for I think these vary more according to environment than according to specific relations, and much change of structure is seen in the roots of the same species, especially between younger and older conditions of it. With a few orders and genera, and perhaps species, it is possible that some anatomical character might be found which would be an aid in classification, but I am certain that among the *Ranunculaceæ* I could not tell the difference between the roots of many of the genera; and as to species I should be entirely at a loss to characterize them by root structure. I emphasize the fact that environment influences structure more than specific relations. For example, all the plants of *Ranunculaceæ* inhabiting wet places, no matter of what species, presented in transection rounded cortex cells, and these loosely packed, the spaces between the cells being numerous and varying in size and number in almost direct proportion to the aquatic or terrestrial habit of the plant. On the other hand, plants of very dry ground generally showed angular cortex cells and almost invariably few and small spaces between them. Another difference noted was that the roots of water *Ranunculaceæ* present a poor development of the vascular system, its office probably being filled by the more abundant spaces between the cells, especially in certain roots in which many of the spaces are continuous cavities surrounded by cells. These differences are well illustrated in plate II, figs. 1 and 3, and plate III, fig. 19, Figs. 1 and 3 represent the roots of *Ranunculus circinatus* and *R. aquatilis* var. *trichophyllus*. Both of these grow in water,

and we find that the cortex cells are round and have many spaces between the cells, while fig. 19 represents the roots of *Actæa alba*, which grows on dry banks, and here the cortex cells are angular and the spaces between cells are almost none. The differences in vascular development are also well shown in these figures.

In this part of the paper I have not discussed the general structure of the species studied as regards the occurrence and distribution of the histological elements, since I find that Marie, Hegelmaier, and others have described the general structure of many species of *Ranunculaceæ*, and in many cases my descriptions would have been but a repetition of theirs.

University of Chicago.

Flowers and insects. X.

CHARLES ROBERTSON.

STEIRONEMA LANCEOLATUM Gray.— The plants are commonly collected in small patches. They grow 3 or 4^{dm} high, and expose a few yellow flowers with reddish-purple centers. The flowers look outwards and a little downwards, and expand from 20 to 25^{mm}. In the bud each corolla lobe enfolds an anther. When the flower expands, the lobes carry the enclosed anthers with them, holding them while the stigma is receptive and is exposed to insects— a fact to which my attention was first called by Professor Pammel. After the anthers are released, the styles are commonly found bent outwards, out of the way of the falling pollen. Sprengel supposed that flowers of *Lysimachia quadrifolia* were nectar bearing, but failed to find nectar. He, and Müller also, failed to find honey in flowers of *L. vulgaris*. According to Kirchner nectar is wanting in *L. nemorum* as well as in *L. nummularia*. I have been uncertain in regard to the occurrence of honey in Steironema, but the visits of male bees seem to indicate its presence, although these insects might search for it in vain. They commonly fly about the flowers to find the females, not trying to find honey.

I have noted the flowers in bloom from June 20th to July 12th. As far as I have observed, they are visited for honey and pollen only by *Macropis steironematis* Rob. ♂♀.

STEIRONEMA LONGIFOLIUM Gray.—This plant resembles the preceding, but grows somewhat taller and bears a greater profusion of flowers. The flowers are without purplish centers. They appear more homogamous, the anthers being more readily released by the lobes, and the style not being bent aside. The flowers were noted in bloom from July 26th to August 23d. The only visitors observed were *Macropis steironematis* Rob. ♂♀, c. p., and perhaps s., abundant, and *Halictus confusus* Sm. ♀, c. p., once.

The flowers of Lysimachia and Steironema seem to hold, as regards their economy, an important mutual relation with bees of the genus *Macropis*. In the "Fertilization of Flowers" Müller states that he found the females of *Macropis labiata*, as a rule, only on flowers of *Lysimachia vulgaris*, and the only other cases cited in that work of the occurrence of *Macropis* on flowers are the visits of the males to flowers of *Œnanthe fistulosa*, *Rhamnus Frangula*, *Melilotus alba* and *Rubus fruticosus*. The other insects observed by Müller on *L. vulgaris* were rare and their visits evidently have no significance. In the Entomologist's Monthly Magazine, XVII, 31–35, Mr. W. H. Patton states that in Connecticut he found *Macropis ciliata* ♀ on flowers of *Steironema ciliatum*, *Rhus glabra*, *R. typhina* and *Archangelica hirsuta*, but says nothing about them collecting pollen. The male was captured on flowers of *Rubus villosus* and *Cornus paniculata*. *M. patellata* ♂ was taken on flowers of either *Cicuta* or *Rhus* and on *Steironema ciliatum*. I have taken *M. steironematis* on flowers of *Ceanothus Americanus*, *Apocynum cannabinum* and *Melilotus alba*, but I have never seen the female collecting any pollen except that of Steironema. We have here a case which as far as mutual dependence goes bears a strong resemblance to the case of Yucca and Pronuba.

FRASERA CAROLINENSIS Walt.—The plants are frequent on rich hillsides, blooming, as far as observed, from May 26th to June 12th. The stem grows as high as two meters, and bears an immense panicle of pale-greenish flowers, which measure about 35^{mm} across.

The flowers are pendulous. The four lanceolate petals expand horizontally. They have whitish bases and greenish tips. On the middle of each petal, about 3^{mm} from its base, is situated a peculiar nectariferous depression, which is oval in outline, about 4^{mm} long by 3^{mm} wide and 1^{mm} deep. This is sur-

rounded by a dense circle of hairs, which form a crest over the cavity and completely conceal the nectar. Some of the hairs are bent downwards, and their tips are turned into the cavity. Besides concealing the nectar from small short-tongued intruders which could not effect pollination, the hairs serve as foot-holds for insects to cling to when extracting the sweets. About this nectary the petals are purple-dotted—the dots serving as path-finders.

Four divergent stamens about 13^{mm} long alternate with the petals, while the stigma occupies the center of the circle. Self-pollination is prevented by the strong proterandry.

When an insect clings to one of the crested nectaries, its body is fairly certain to touch the anthers on that side, as well as the stigma. The size of the flower, however, indicates that the insect, in order to do this, must be of large size. I expected to see the flowers visited by bumble-bees, which, after all, may prove to be the principal visitors, but after watching them on June 10th and 11th the only insect observed sucking, which could effect pollination, was *Polistes metricus* Say ♀. It clings to the stamens and style with its posterior legs and can readily strike the anthers and stigma. *Halictus coriaceus* Sm. ♀ visits the flower for honey and pollen, but is too small to do any good.

ELLISIA NYCTELEA L.—The plant is common, rises about 2^{dm}, is scattered in thin patches, and is commonly rendered quite inconspicuous by the surrounding vegetation. The rather diffuse branches bear only a few flowers, which bloom in succession, so that, in their visits, insects are as likely to pass between flowers of distinct plants as from flower to flower on the same plant. The flowers vary in position from erect to pendulous, the calyx lobes, which equal the corolla in length, often concealing it from view.

The corolla measures about 4 or 5^{mm} in length and expands about 6^{mm}. The tube is about 4^{mm} long and is as wide as 2^{mm}, so that it readily admits the head and thorax of small bees. The border is turned out nearly horizontally and is divided into five rounded lobes. With the exception of three to five purplish dots on the middle of the lobes, the color is white. A few hairs on the inner wall of the corolla tube seem to have little significance.

Five stamens alternate with the corolla lobes and bend to the center of the flower, so that to reach the nectar, insects

are required to insert their tongues between the filaments. Each filament has on each side of its base a fimbriate appendage which tends to close the interval. Then the ovary is densely clothed with erect bristle-like hairs which also aid in concealing the nectar. The disk surrounding the base of the ovary shows five nectar secreting processes alternating with the filaments.

The flower is homogamous. The style with its receptive stigma rises among the dehiscent anthers, being generally overtopped by them, so that self-pollination may readily occur with or without insect aid.

Probably on account of strong competition with its allies and other plants the flower seems to have gone through a stage in which it was neglected by insects and was compelled to rely upon self-pollination. At present I find it abundantly visited, to an extent that would seem to justify the return of dichogamic characters.

But the damp shady situations in which the plant grows, no doubt, render the visits of insects quite uncertain, so that the power of spontaneous self-pollination becomes a most important condition of selection. The flower is adapted to small bees, especially *Halictus*. It blooms from April 21st to June 21st. May 8th, 12th and 21st the following visitors were observed:

Hymenoptera—*Apidae:* (1) Ceratina tejonensis Cr. ♂, ab.; (2) C. dupla Say ♂♀, ab.; (3) Osmia albiventris Cr. ♂; (4) O. atriventris Cr. ♂♀; (5) Nomada maculata Cr. ♀; *Andrenidae* (6) Andrena violae Rob. ♀; (7) A. ziziae Rob. ♂; (8) Augochlora pura Say ♀, ab.; (9) Halictus 4-maculatus Rob. ♀, ab.; (10) H. pectoralis Sm. ♀; (11) H. fasciatus Nyl. ♀, ab.; (12) H. obscurus Rob. ♀, ab.; (13) H. zephyrus Sm. ♀; (14) H. tegularis Rob. ♀; (15) H. stultus Cr. ♀—all s.

Diptera—*Bombylidae:* (16) Bombylius pulchellus Lw., s.; (17) B. fratellus Wd., s.; *Syrphidae:* (18) Pipiza femoralis Lw., f. p.; (19) Mesograpta marginata Say, f. p.; (20) M. geminata Say, f. p.; (21) Rhingia nasica Say, s.

COMANDRA UMBELLATA Nutt.—The flower is remarkable for being specially adapted to flies. The calyx is white and expands about 5^{mm}. It is generally 5-, sometimes 3- or 4-parted. The tube is 2 or 3^{mm} long, lined within by a green disk which above forms lobes alternating with the stamens and calyx lobes. This disk, especially at its exposed lobes, secretes

nectar which is very attractive to flesh-flies. Visitors have abundant pollen massed about the bases of their proboscides.

The flowers are homogamous. The stigma somewhat surpasses the anthers and is separated from them. I do not think spontaneous self-pollination occurs, unless it be in bad weather.

The plants are common, often in large patches, grow from 1 to 2^{dm} high and expose an umbel-like cluster of flowers. The flowers bloom from April 27th to June 6th. The following list of visitors was observed on May 12th, 16th, 17th, and 19th:

Diptera — *Syrphidae:* (1) Sphaerophoria cylindrica Say, ab.; (2) Volucella vesiculosa F.; (3) Eristalis dimidiatus Wd.; (4) Helophilus latifrons Lw.; (5) Tropidia mamillata Lw.; (6) Syritta pipiens L.; *Tachinidae:* (7) sp.; (8) Trichophora echinomoides Twns.; (9) Gonia frontosa Say; *Sarcophagidae:* (10) Cynomyia sp., very ab.; (11–13) Sarcophaga spp., very ab.; *Muscidae:* (14) Calliphora erythrocephala Mg., freq.; (15) C. vomitoria L.; (6) Lucilia sp., very ab.; (17) L. caesar L., ab.; (18) L. latifrons Schin., freq.; (19) L. sericata Mg., two; (20) L. cornicina F.; (21) L. sylvarum Mg., very ab.; (22) Graphomyia sp.; (23) Myospila meditabunda F.; *Anthomyidae:* (24) Limnophora sp., ab.; (25) Chortophila sp.; (26) Coenosia sp.; *Sciomyzidae:* (27) Tetanocera sp. — all sucking.

Hymenoptera — *Apidae:* (28) Apis mellifica L. ☿; (29) Synhalonia speciosa Cr. ♂; (30) Osmia albiventris Cr. ♀; (31) Nomada superba Cr. ♂; *Andrenidae:* (32) Andrena sayi Rob. ♀; (33) A. flavo-clypeata Sm. ♀; (34) A. mariae Rob. ♀; (35) Halictus lerouxii Lep. ♀; (36) H. confusus Sm. ♀; (37) H. albipennis Rob. ♀; (38) H. tegularis Rob. ♀; (39) Sphecodes arvensis Pttn. ♀ — all sucking, rare.

Coleoptera — *Coccinellidae:* (40) Megilla maculata DeG., one; *Lampyridae:* (41) Telephorus bilineatus Say, one — both sucking.

SPIRANTHES GRACILIS Bigelow.[1] — The flowers are white and measure 4 or 5^{mm} long. The parts of the perianth, with the exception of the divergent lower sepals, are disposed so as to limit access to the nectar. The upper sepal is connivent with the two upper petals, forming the upper wall of the tube. At their free ends these parts form a three-toothed upper lip. The lower wall is formed by the labellum, whose

[1] See Darwin: Fertilization of Orchids; Gray: Am. Journ. Sci., xxxiv.

tip forms a lower lip. This is too small to form a landing-place for insects, but makes the flower a little more conspicuous. A proboscis about 4^{mm} long can drain the nectar with ease.

In Gray's Manual the time of blooming is stated to be from July to October, while in Chapman's Flora of the Southern States it is said to be in April and May. In Illinois I have found the plant in bloom in September. At Orlando, Florida, I noted it in bloom from February 18th to March 16th; and at Inverness, Citrus county, from March 15th to 23d. In Illinois I have seen the flowers visited by *Bombus americanorum* F. ♂ and *Calliopsis andreniformis* Sm. ♀. At Orlando, Florida, I saw them visited by a bee which I failed to capture, but which I supposed was *Anthidium notatum* Latr., and by *Megachile brevis* Say ♂.

The last mentioned insect has two boat-shaped discs with attached pollinia fastened to the maxillary laminæ, and I think this is the particular part of a bee to which the flower is adapted to fasten its pollinia. At Torquay, Darwin saw *S. autumnalis* visited by two species of bumble-bees. In one specimen which he examined he states that the pollinia were attached to the superior (maxillary) laminæ. The maxillary laminæ are on the upper side when the proboscis is inserted into a flower, and are the parts which would be expected to touch the disk first. But the most important consideration is that when the bee's proboscis is folded up under the head, the maxillary laminæ fall into such a position that the pollinia retain their hold without danger of being disturbed.

ORCHIS SPECTABILIS L.[2]—In my neighborhood there are many places favorable for the protection of this Orchis, and it is of rather frequent occurrence. It is found on north hillsides in rather shady places. The scapes grow from 1 to 2^{dm} high and bear several flowers. The labellum with its spur is white. It is nearly pendant and measures from 10 to 15^{mm} long by 8 to 10^{mm} wide. The other parts of the parianth are united into a purplish helm which effectually shelters the column and the mouth of the spur. The spur is from 12 to 15^{mm} long, is somewhat enlarged near the tip, and the nectar rises 2 to 3^{mm}.

The flower is specially adapted to *Bombus* females. At the

[2] See Guignard: 16th ann. rep. Ent. Soc., Ontario; Mignault: Bemerkungen über die Befruchtung der Pflanzen.

time when it blossoms (May) only the females of *Bombus* are flying. The disks are applied to the bee's clypeus, which in the female is bare. The clypeus of the male is so hairy that the disks could hardly be properly fastened to them. Long-tongued species of *Anthophora* and *Synhalonia* are flying while the flowers bloom and can reach the nectar, but I do not believe the flowers are adapted to them, because the males, which fly at the same time, have hairy faces, and they would be as apt to visit the flowers. When the pollinia are withdrawn by a bee they stand in a nearly horizontal position, since the bee's clypeus has its face directed nearly vertically, so that in moving downwards to a position in which they will strike the stigma they must be assisted by their own weight.

On May 13th I found a patch of five plants, which bore twenty flowers. With the exception of three flowers, the pollinia were removed from all, and most of the stigmas had received pollen. I saw the flowers visited by the females of *Bombus separatus* Cr. and *B. americanorum* F. The proboscis of the former can drain the short-spurred flowers and obtain some of the nectar which rises in the long spurs. *Bombus americanorum* can easily exhaust the longest spurs. A specimen of this bee which I captured at the flowers has a pair of pollinia on the clypeus.

HABENARIA LEUCOPHLEA Gray.—The plant is rare. It grows on prairies. The stem rises from 4 to 8^{dm} and bears a raceme of greenish white flowers. The flower measures about 20^{mm} long by 15^{mm} wide.

The upper sepal and two upper petals form a galea which shelters the anther. The labellum is three parted, each division being fimbriate. The disks are set one on each side of the entrance to the spur and are separated about 2^{mm}, so that when the hawk-moth throws its proboscis to one side or the other, it is apt to remove one of the pollinia, but is not likely to extract both of them. The spur is very slender and measures from 35 to 40^{mm} in length, indicating that the flower is adapted to Sphingidae. The nectar does not seem to be enclosed between the walls of the spur but appears to occupy the cavity. The height to which it rises can be seen from the outside. Sometimes it fills the spur for 10^{mm} above the tip.

I have found the plant in bloom from June 12th to July 12th. July 2nd I captured at the flowers a specimen of *Chaero-*

campa tersa L. with three disks on its proboscis, about 4^{mm} from the base. At Champaign, Ill., Mr. M. B. Waite showed me a specimen of *Philampelus achemon* Dru., which he had taken on the flowers. It had pollinia about 5^{mm} from the base of the proboscis.

Carlinville, Illinois.

Notes on North American Umbelliferæ. III.

JOHN M. COULTER and J. N. ROSE.

WITH PLATE V.

The two preceding papers of this series were published in this journal November, 1889, and October, 1890. The present paper is a report upon the Umbelliferæ of Mr. John Donnell Smith's third distribution of Guatemalan plants. Most of the species were sent by H. Th. Heyde and Ernst Lux, who have made extensive collections for Mr. Smith. We have previously reported upon Guatemalan Umbelliferæ in this journal for January and October, 1890.

HYDROCOTYLE MEXICANA Cham. & Schl.—Rio Negro, Dept. Quiché, at an altitude of 3,600^{ft}, June, 1892, no. 3,350. Collected by Heyde & Lux.

HYDROCOTYLE PROLIFERA Kell.—Amatitlan, Dept. Amatitlan, at an altitude of 3,990^{ft}, May, 1892, no. 2,668. Collected by John Donnell Smith. This seems to be the same species collected at this place by Mr. Smith in 1889, and referred to in BOT. GAZ. XV. 259. Also from Santa Rosa, Dept. Santa Rosa, at an altitude of 3,000 to 4,000^{ft}, April, 1892, no. 3,349. Collected by Heyde & Lux. This plant is less proliferous, the umbel sometimes being simple as in *H. umbellata*.

SPANANTHE PANICULATA Jacq.—Santa Rosa, Dept. Santa Rosa, at an altitude of 3,000 to 4,000^{ft}, June 1892, no. 3,351. Collected by Heyde & Lux.

ERYNGIUM CARLINÆ Delar.—San Miguel Uspantán, Dept. Quiché, at an altitude of 6,000 to 12,000^{ft}, April, 1892, no. 3,356. Collected by Heyde & Lux.

SANICULA MEXICANA DC.—San Miguel Uspantán, Dept. Quiché, at an altitude of 6,000 to 12,000^{ft}, April, 1892, no. 3,357. Collected by Heyde & Lux.

C.E. Faxon, del.

ENANTIOPHYLLA HYDEANA, Coulter & Rose.

B. Mansel, Lith. Boston

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ARRACACIA DONNELLSMITHII C. & R.—Volcan de Agua, Dept. Zacatepequez, at an altitude of 10,000 ft. Collected near the type locality by W. C. Shannon, June, 1892.

Arracacia Luxeana, n. sp.—Probably a tall perennial, branching, glabrous: leaves ternate to triternate; petioles wholly inflated; leaflets ovate to lanceolate, 2.5 to 7.5^{cm} long, sharply serrate, glabrous: peduncles short (10 to 12^{cm} long) or wanting: umbel somewhat unequally 15 to 30-rayed, with involucre wanting or of a single leaflet; involucels four to eight, foliaceous, lanceolate, sharply serrate, often 2.5^{cm} long; rays 5 to 10^{cm} long; pedicels 8 to 14^{mm} long: fruit ovate, acute, 6 to 8^{mm} long, glabrous, flattened laterally, with slender conical stylopodium: carpel terete, with five prominent ribs; commissure narrow; oil tubes solitary in the intervals, two on the commissural side: seed with deeply sulcate face and furrowed under the intervals.—In the forest near San Miguel Uspantán, Dept. Quiché, at an altitude of 6,000 to 12,000^{ft}, April, 1892, no. 3,354. Collected by Lux.

EULOPHUS PEUCEDANOIDES Benth. & Hook.—Santa Rosa, Dept. Santa Rosa, at an altitude of 3,000 to 4,000^{ft}, May, 1892, no. 3,353. Collected by Heyde & Lux.

ENANTIOPHYLLA, n. gen.—Calyx-teeth obsolete. Fruit oblanceolate, flattened dorsally, glabrous. Carpel strongly flattened dorsally: dorsal and intermediate ribs prominent, acute; lateral ribs winged. Stylopodium slender, conical; styles furrowed on ventral face, slightly thickened above but not capitate. Oil-tubes solitary in the intervals, two on the commissural face. Seed strongly flattened dorsally, with a broad, shallow excavate face and furrowed under the intervals.—Tall glabrous perennials, with opposite ternately-compound leaves, lanceolate acute leaflets, linear bracts and bractlets, and white (?) flowers.

This genus belongs to Bentham and Hooker's subtribe ANGELICEÆ. From *Angelica* and *Prionosciadium* it differs chiefly in its conical stylopodium and opposite leaves. In fact, in the latter character it differs from most genera of *Umbelliferæ*, and has suggested the generic name. The genus is peculiar in having the carpel developed at the base into a broad stipe or foot, much as in Dr. Robinson's new genus *Coulterophytum*, but not so marked. It has several other characters in common with the latter genus, but has a

more compressed fruit and carpel, prominent dorsal and intermediate ribs and winged lateral ones, etc., etc.

Enantiophylla Heydeana, n. sp. Plate V.—From 12 to 15^{dm} high and much branched: leaves large, 3-ternate or 2-ternate-pinnate, or the upper ones simply ternate or pinnate; leaflets lanceolate, acuminate, 5 to 7.5^{cm} long, glabrous above, paler and minutely scabrous on the veins, sharply and finely serrate; petiole broad and inflated: inflorescence large; upper branches verticillate, terminated by an umbel; peduncle 3 to 7.5^{cm} long; rays 12 to 30^{mm} long; pedicels 6 to 8^{mm} long: bracts of involucre and involucel several, linear, and with scarious margins: fruit 10^{mm} long; wings of lateral ribs about as broad as body; the dorsal ribs sharp and equal.—Collected by Rosalió Gómez, in fruit, at Santiago, Depart. Zacatepequez, at an altitude of 6,500^{ft}, 1891; and by Heyde, in flower, along the banks of the Rio Esclavo (where it is said to be common) near Santa Rosa, Depart. Santa Rosa, at an altitude of 3,000^{ft}, May, 1892. Distributed by John Donnell Smith under nos. 788 and 3,352 respectively.

CORIANDRUM SATIVUM L.—Introduced. Santa Rosa, Dept. Santa Rosa, at an altitude of 3,000^{ft}, July, 1892, no. 3,347. Collected by Heyde and Lux.

DAUCUS MONTANUS Willd.—San Miguel Uspantán, Dept. Quiché, at an altitude of 6,000 to 12,000^{ft}, April, 1892, no. 3,355. Collected by Heyde & Lux.

Bloomington, Ind., and Washington, D. C.

Influence of anæsthetics on plant transpiration.[1]

ALBERT SCHNEIDER.

WITH PLATE VI.

I. Historical and critical.

Recently Jumelle conducted some very interesting experiments on the influence of anæsthetics on plant transpiration. He made an extensive study of plant chemism, chlorophyll-function and transpiration, which led him to give his final report on plant anæsthesia in the July number, 1891, of the

[1] The researches described in this paper were carried on in the laboratories of physiological botany of the University of Minnesota at Minneapolis.

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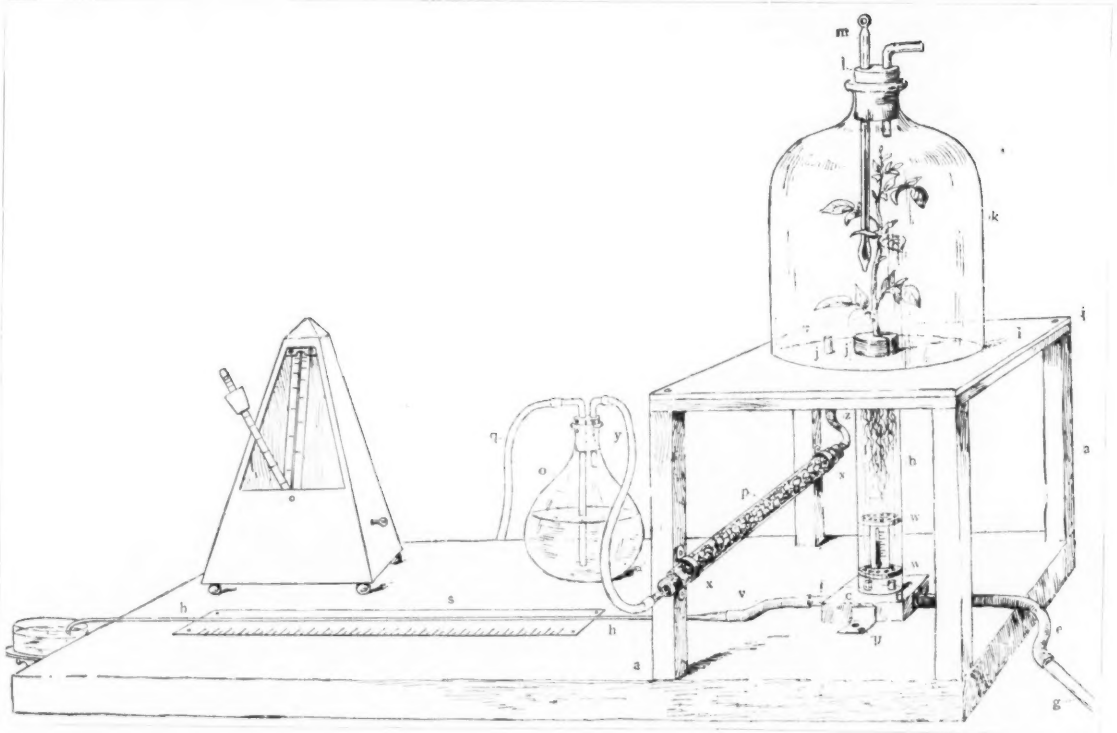

SCHNEIDER on TRANSPIRATION

Revue Générale de Botanique. A very brief summary of his conclusions may be stated as follows:

1. The luminous rays of the sun are partially utilized in assisting assimilation and partially in increasing "chlorophyllian transpiration."

2. Part of the luminous rays are absorbed by the chlorophyll bodies and converted into heat, increasing vapor tension and thus aiding transpiration.

3. The same dose of sulphuric ether acts differently on plant transpiration in the light and the dark. In light transpiration is increased but in the dark retarded.

4. Augmentation in light of transpiration of the anæsthetized plant is due to the influence of the sulphuric ether on the chlorophyll bodies

5. The cause of retardation in the dark is not definitely explained.

6. Ether retards assimilation but increases chlorophyllian transpiration (in the light).

7. Ether partially arrests assimilation and the luminous rays no longer used in the assimilating function aid the chlorophyllian transpiration.

8. The same results are reached when assimilation is retarded by any means.

As will be seen from these conclusions, Jumelle adheres to the chemical theory of chlorophyllian transpiration as do also Wiesner and others. Pringsheim, Kohl, and others maintain that the influence of chlorophyll is purely mechanical, acting as a sort of a shade to protect the plastid from certain rays of sunlight. It is a well known fact that plants transpire, though devoid of chlorophyll, as in etiolated plants. The question as to the correct theory of plant transpiration need not be further discussed here. I simply wish to show how Jumelle came to what I think are erroneous conclusions. Jumelle has lately been carrying on a controversy with Verschaffelt who maintains that ether increases transpiration in the dark as well as in the light. This Jumelle has attempted to disprove in his final paper on anæsthetized plants.

By way of criticism it must be pointed out that, in the first place, Jumelle as well as Verschaffelt used only portions of plants in their experiments and hence their conclusions are of little practical value. In the second place they very possibly confounded *evaporation* with *transpiration* as I shall attempt

to show. It is well known that dead plant tissue loses water vapor much more rapidly than living tissue. There can be no transpiration in dead tisue; it is evaporation, and that is a distinctively mechanical process. Transpiration takes place in living tissues only and is dependent upon protoplasmic action. Anything that reduces protoplasmic activity will therefore reduce transpiration.

II. Experiments on protoplasmic movements.

It has been known for some time that ether reduces the activity of animal protoplasm. Since all forms of protoplasm are supposed to be essentially alike it is to be expected that ether will have a similar effect upon vegetable protoplasm. For the purpose of studying the effects of ether vapor on vegetable protoplasm I used cross sections of the leaf, bearing hair cells, of *Primula sinensis*, *Petunia violacea*, and *Lycopersicum esculentum*. These sections were placed in a hanging drop of water without a cover glass, with a suitable arrangement to expose the preparation to the ether vapor at any desired moment. Only a very short period (2 or 3 seconds) was sufficient to cause the protoplasm to collect in spheroidal masses which after a shorter or longer period returned to the normal condition. The following are some of the results obtained.

Conditions of light, temperature, and moisture were constant in all the experiments.

1. *Primula sinensis.*

Numbers indicate time, in seconds, required for a certain protoplasmic granule to move 10μ.

First experiment.

Normal: 5, 4, 6, 5, 4, 5, 5, 4, 6, 5, 5, 4, 5, etc.
After momentary exposure to ether vapor, 4, 5, 5, 6, 6, 7, 6, 7, 7, 8, 8, 9, 9, 10, 10, 10.
Remained stationary at about 10 then returned to normal: 10, 9, 10, 9, 8, 8, 7, 7, 7, 6, 5, 5.

Second experiment; fresh sections.

Normal; 5, 6, 7, 5, 6, 5, 6, 5, 5, 6, 6, 5, 6, 6, 5, etc.
Exposed to ether vapor for 2 seconds; 6, 7, 7, 8, 9, 11, 11, 13, 14, 14, 15, 14, 14.
Remained stationary at about 14 then returned to normal: 14, 14, 13, 13, 12, etc.

2. *Petunia violacea.*

First experiment.

Normal: 6, 5, 5, 6, 6, 5, 5, 5, 6, 5, 6, 5, 5, etc.
Exposed to ether vapor for 4 seconds: 7, 8, 7, 8, 9, 10, 11, 11, 14, 15, 18, 19, 22, 40, 50, etc., until all motion permanently ceased.

Second experiment; fresh sections.

Normal: 5, 6, 5, 6, 5, 5, 6, 5, 6, 5, etc.
Momentary exposure to ether vapor: 5, 5, 6, 7, 7, 7, 8, 8, 9, 9, 8, 9, 8, 9, 8, 7, 7, 7, 6, 6, 5, 5.

Third experiment; fresh sections.

Normal: 5, 6, 7, 6, 6, 5, 5, 6, 6, 7, 6, 5, 6, etc.
Exposed to the ether vapor for one or two seconds: 5, 6, 6, 6, 7, 7, 7, 6, 7, 7, 8, 8, 9, 11, 12, 14, 15, 16, 16.
Remained stationary at 16 then returned to normal.

3. *Lycopersicum esculentum.*

Normal: 4, 5, 4, 5, 5, 4, 5, 5, 4, 5, 5, etc.
Momentary exposure to ether vapor: 4, 5, 6, 6, 7, 8, 10, 12, 14, 14, 15, 16, 16, 17, 17, 16, 17.
Then returned to normal.

From these experiments it will be seen that ether vapor reduced protoplasmic action, temporarily when exposed for a short time and permanently when exposed for a longer time. I might mention incidentally that ether vapor had no perceptible effect upon the position, size, or shape of the chlorophyll bodies.

III. Experiments on transpiration of entire plants.

Having noted the effect of ether vapor upon protoplasmic activity and believing that transpiration depends on protoplasmic activities, we may next proceed to the transpiration experiments proper. As already mentioned the experiments of Jumelle, and likewise those of Verschaffelt and Lommen, are really of little practical value because these investigators did not use the entire plant, root and all. In the following experiments I have employed a modified and improved Kohl transpiration apparatus which permits the use of the entire plant.[2]

Owing to the fact that this apparatus gives very delicate results and hence is easily influenced by slight changes of environment the following precautions must be observed in its use.

1. There must be no air bubbles in any part of tubes *b*, *h*, and *g*.[2]

[2] See plate VI and explanation.

2. The capillary tube, *h*, especially must be free from air-bubbles and other impurities.

3. All fittings to tube *b* must be air tight.

4. The tube *b* must be entirely filled with water.

5. The water used should be boiled to remove air.

6. The temperature of air and water must be stationary before observations are made.

7. Nothing must be placed in *b* that will generate gases, as culture fluids, etc.

8. The same plant must not be retained in tube *b* for more than 12 hours.

9. The water in tube *b* must be changed every time the plant is changed.

These precautions may assist in preventing faulty experimenting on the part of those who may not as yet have used a similar apparatus.

From a series of experiments I found that the daily period of maximum transpiration corresponds to the daily period of maximum growth (one to four o'clock P. M.). This seems to be additional evidence that transpiration depends upon assimilation.

I. RELATION OF LIGHT TO EFFECT OF ANÆSTHETICS.

The plant used in the following series of experiments was *Solanum tuberosum*. In all cases the plant was covered by the bell jar and dry air forced through by means of a pair of foot bellows. The air was dried by means of sulphuric acid and chloride of calcium. Of course the entire plant was used, root and all, care being taken not to mutilate the fine rootlets more than was unavoidable. No observations were made until the temperature of the air and water was nearly constant.

1. *Solanum tuberosum*, small plant, seven leaves, three small, developing tubers; in diffused light.

Time	Tem. of water °C.	Tem. of air °C.	Normal or Anaest.	Time in seconds required to evaporate 5^{mm} of water column.	Average time.	Progress.
3:30	21½°	22⅔°	Normal	7, 7. 8, 7, 6, 8, 7, 7, 8, 7, 6, 7, 8, 7	7.2	Ether introduced
3:34	21½°	22½°	Ether.	7. 8. 7, 7, 6, 7, 8, 9, 9, 8, 9, 9, 10, 9		
				10, 11, 11, 11, 12. 12, 12, 13. 13	7.2–11.4	Ether removed.
3:50	21½°	22½°	Normal	12, 11. 12. 11. 10. 8, 7. 8, 7, 7. 8, 7	11 4–7.2	
4:20	21°	20½°	Normal	7, 7. 8. 7, 7, 8, 8, 7, 7. 7. 8, 7. 8. 7	7.3	Amyl nit. intr'ed
4:24	21°	20½°	Amı nit	7, 7. 8, 7, 7. 8, 7. 8. 8. 8, 7, 8. 8.	7.5	After 5 min. amyl
4:32	21°	20½°	Amı nit	12. 11 12, 13, 13, 12 14. 13.....	12.37	nit. removed.
4:45	20 5-6°	20¼°	Normal	13, 13, 12, 12, 13, etc. to normal.	12–7.5	End.

2. *Solanum tuberosum*, small plant, eight leaves, no tubers; in diffused light.

Time	Tem. of water °C.	Tem. of air °C.	Normal or Anaest.	Time in seconds required to evaporate 5^{mm} of water column.	Average time.	Progress.
11	21⅔°	24.5°	Normal	10, 11, 11, 10, 12, 11, 10, 12, 11	10.8	Ether introduced
11:14	21⅔°	24.5°	Ether.	11, 11, 10, 11, 11, 12, 11, 12, 12	11+	After 10 minutes
11:18	21¾°	24.5°	Ether.	16, 17, 17, 16, 17, 17, 16, 18, 17	16 7-9	ether removed.
11:23	21¾°	24.5°	Normal	16, 16, 14, 13, 13, 12, 11, 10, 11	16-10	End.
Ether introduced and left until 2 P. M.						
2:00	23°	24.9°	Ether.	75, 73, 75, 72, 70, 73, 75	73	Ether removed
2:15	23°	24.9°	Normal	75, 70, 73, 71, 74, 73, 72, 70.....	72	after 10 min.
2:30	23°	24.9°	Normal	36, 35, 36, 32, 35, 34, 34	32.5	End.

It will be seen that the plant did not return to its normal transpiration after it had been exposed to ether vapor from 11:30 A. M. to 2:00 P. M. The ether had partially killed the plant as the subsequent drying up and shriveling of the tips and margins of some of the leaves served to indicate.

3. *Solanum tuberosum*, small plant, six leaves, no tubers; in direct sunlight.

Time	Tem. of water. °C.	Tem. of air, °C.	Normal or anæsthet.	Time in seconds required to evaporate 5^{mm} of water column.	Average Time.	Progress.
2:30	22¼°	30°	Norm'l	5, 6, 5, 6, 5, 5, 6, 5, 6, 6, 5, 5.....	6.1	Ether introduced
2:34	22¼°	30°	Ether ..	6, 5, 6, 6, 6, 7, 7, 8, 8, 9. 8, 9, 9, 9	6-9	Ether removed.
2:36	22¼°	30°	Norm'l	8, 8, 7, 6, 6, 5, 6, 5, 5, 6, 6, 5.....	9-6	Chlorof'm int'ced
2:38	22¼°	30°	Chl'frm	5, 5, 6, 5, 6, 6, 5, 6, 7, 6, 7.7, 8, 9	6-9—	Chlorof'm rem'vd
2:10	22¼°	30°	Norm'l	8, 8, 7, 7, 6, 6, 5, 6, 5, 5, 6, 5.....	9-6—	

These experiments seem to show conclusively that a plant exposed to the vapor of ether, amyl nitrite or chloroform, will have its transpiration very materially diminished. I took no special notice of the amount of anæsthetic used because I soon found that the effect was the same independent of the quantity used. Of course a small quantity required a longer time to produce given effects. Ether and chloroform I poured in any vessel from which it could evaporate. Amyl nitrite was used by putting two or three drops on a piece of cotton under the bell jar. It will be remembered that during all these experiments a current of dry air was passed through the bell jar, carrying with it most of the vapor; still there was sufficient left to produce the given results. Exposing the plant to amyl nitrite vapor for ten or fifteen minutes was suf-

ficient to kill the greater portion of it. It could withstand a much longer period of exposure to ether and chloroform vapors.

The following set of experiments, 4 to 6, relate to the influence of anæsthetics on plant transpiration when the plant is exposed to the various colors of the solar spectrum. I found it rather difficult to obtain pure colors. The colors I desired were red, yellow and green. Red and green I was able to obtain quite pure; but it was impossible for me to obtain yellow that did not also transmit red. The following is a list of substances with result of spectrum analyses. The thickness of the liquid was in all cases 13^{cm}.

Color.		Dye used.	Rays transmitted.
Red.	1	Eosine	From 65 to 75.
	2	Carmine	From 66 to 73.
	3	Fuchsine	From 68 to 75.
	4	Safranine	From 67 to 75.
	5	Magdala red	From 64 to 75.
Yellow.	1	Methyl orange	From 56 to 75.
	2	Gold orange	From 58 to 75.
	3	Orange	From 57 to 75.
	4	"Diamond dye" yellow	From 55 to 75.
Green.	1	Iodine green	From 45 to 56.
	2	Methyl green	From 45 to 57, and 72 to 75.
	3	Malachite green	From 46 to 56, and 72 to 75.
	4	Alcoholic chlorophyll solution	From 40 to 70.
	5	Copper chloride solution	From 40 to 70.
	6	Diamond dye yellow and blue	From 49 to 56.
Black.	1	Diamond dye black	Faint trace of all rays.
White.	1	Water	All rays of solar spectrum.

From these and various other colors which I examined, I selected fuchsine for red; "diamond dye" yellow, for yellow; a mixture of diamond dye yellow and blue, for green. Of these I made watery solutions in large double-walled bell-jars that could be placed over the plant on the apparatus in place of the ordinary bell-jar. Diamond dyes have an advantage in that the watery solutions do not form a sediment like many of the aniline dyes; they seem also to fade less quickly.

The transparency of colored liquids was made approximately alike, likewise was the thickness of the liquids in the various jars, and different parts of the same jar only approximate. Owing to the fact that a complete series of experiments must

be made with the same plant at one sitting, and since the period of constant temperature and illumination during the day is short, I could not obtain such marked results as I could have obtained with longer periods of time. Also, the jars used were larger than the bell jars used in the second series of experiments; hence the effects of the anæsthetics did not appear as quickly, nor were the results so marked.

4. *Fuchsia* sp.? ; small, five leaves, small roots, no flowers.

Time	Color.	Tem. of liq. °C	Tem. of air °C.	Tem. of water °C.	Anaest. or normal	Time in seconds required to evaporate 5 mm of water column.	Progress.
3.00	White	23.5	24	22	Normal	15, 16, 15, 16, 16, 15, 16, 16, 15.	Ether intr'd.
3:04	dif. l.	23.5	24	22	Ether.	15, 16, 17, 15, 16, 15, 16, 16	After 6 minutes
3:10	"	23.5	24	22	Ether.	17, 18, 18, 18, 19, 18, 19, 19, 18	ether removed.
3:16	"	23.5	24	22	Normal	15, 16, 15, 15, 16, 16, 16, 15, 16	4 minutes.
3:19	Dark.	23	24	22+	Normal	16, 15, 15, 16, 15, 16, 16, 13, 16	Dark.
3:34	"	23	24	22.25	Normal	18, 18, 19, 18, 18, 19, 18, 18, 19	Aft. 15 m. et. in'd.
3:36	"	23	24	22.25	Ether.	20, 18, 18, 18, 19, 19, 18, 19	Aft. 5m. eth. rem.
3:42	"	23	24	22.25	Ether.	20, 21, 22, 21, 22, 21, 22	4 minutes.
3:49	"	23	24+	22.5	Ether.	18, 19, 18, 18, 19, 18, 19, 18, 18	End.

5. *Solanum tuberosum*, small plant, strong roots, no tubers.

Time	Color.	Tem. of liq. °C	Tem. of air °C.	Tem. of water °C.	Anaest. or normal	Time in seconds required to evaporate 5 mm of water column.	Progress.
11:20	White	21	22	20	Normal	10, 9, 10, 10, 9, 10, 9, 10, 10, 9	Ether intr'd.
11:22	dif. l.	21	22	20	Ether.	10, 9, 10, 10, 10, 9, 9, 10, 9, 10	After 8 minutes
11:30	"	21	22	20	Ether.	13, 12, 13, 13, 13, 12, 13, 12	ether removed.
11:35	"	21	22	20	Normal	10, 9, 10, 10, 9, 9, 10, 9, 9, 10, 10	Amyl nit. intr'd.
11:37	"	21	22	20+	Amyl n	10, 9, 10, 9, 10, 10, 10, 10, 9	After 3 minutes
11:41	"	21	22+	20	Amyl n	13, 13, 12, 13, 13, 13, 12, 13	amyln. removed.
11:46	"	21	22	20	Normal	10, 9, 9, 10, 10, 10, 9, 10, 9, 9	
11:48	Dark.	21.5	22	20	Normal	10, 9, 10, 9, 10, 10, 9, 10, 10, 9	Dark.
12:02	"	21	22	20	Normal	12, 12, 12, 13, 12, 12, 13, 12	After 15 minutes
12:05	"	21	22	20	Amyl n	12, 12, 12, 13, 13, 12, 13, 12	amyl nit. intr'd.
12:11	"	21	22	20	Amyl n	14, 13, 13, 14, 14, 15, 14, 14	Af. 5 m. am'l rem.
12:16	"	21	22	20	Normal	12, 13, 12, 13, 13, 12, 13, 12	End.

These experiments show that ether as well as amyl nitrite reduces transpiration both in light and dark. I was very careful to have conditions of temperature and moisture the same in all cases. The above are only a few of a large number of similar results obtained. Variation in temperature, etc., caused me to repeat many of the experiments before I obtained satisfactory results.

The following is a series of experiments in which I used colored liquids, namely red and green, which were almost pure as seen from the table of spectrum analysis, and yellow which transmitted a trace of green, all the yellow, orange and red. To make the series complete I also repeated the experiments with white light and in darkness.

Without going into the discussion in regard to the influence of colored light on plant transpiration and assimilation, I will give the average results obtained from a series of experiments. The conditions of temperature and moisture were constant in all cases.

White light, diffused, required				54	seconds to evaporate		25	mm.
Yellow	"	"	"	60	"	"	25	"
Red	"	"	"	62	"	"	25	"
Green	"	"	"	64	"	"	25	"
Darkness			"	72	"	"	25	"

The results obtained agree quite closely with those obtained by Déhérain, Engelmann and Kohl. Timiriaseff and Engelmann maintain that there is another position of maximum assimilation and transpiration in the blue; leaving that out of the question, I think that nearly all plant physiologists affirm that assimilation and hence transpiration is most active in the more luminous rays of the solar spectrum.

6. *Solanum tuberosum*, small plant, strong roots, no tubers.

Time	Color.	Tem. of liq. °C	Tem. of air °C.	Tem. of water °C.	Anaest. or normal	Time in seconds required to evaporate 5 mm of water column.	Progress.
11:30	White	21.5	22	21.5	Normal	11, 11, 11, 10, 11, 11, 10 10, 11, 11, 10	Ether introduced
11:34	dif. l.	21.5	22	21.5	Ether.	11, 11, 11, 12, 11, 10, 11, 11, 11, 12	After 10 min.
11:46	"	21.5	22	21.5	Ether.	13, 14, 13, 13, 14, 13, 14, 14 13	ether removed.
11:19	"	21.5	22	21.5	Normal	11, 11, 11, 10, 10, 11, 10, 11, 11, 11	Yellow l.
11:53	Yellow.	21	22	21.5	Normal	11, 11, 11, 10, 11, 11, 11, 11, 10, 11, 11	After 10 min.
12:04	"	21	22	21.5	Normal	12, 11, 12, 13, 12, 11, 12, 11, 13	ether introduced
12:10	"	21	22	21.5	Ether.	15, 14, 14, 15, 14, 14, 15, 14	Ether removed.
12:20	"	21	22	21.5	Normal	12, 11, 12, 12, 11, 12, 12, 11, 12	Red l.
12:25	Red.	21.5	22	21.75	Normal	12, 11, 12, 12, 11, 12, 11, 12, 13	After 10 min.
12:38	"	21.5	22	21.75	Normal	12, 13, 13, 12, 13, 13, 12, 13, 13	ether introduced
12:15	"	21.5	22	21.75	Ether.	15, 16, 16, 15, 15, 16, 16, 15, 16	Ether removed.
12:19	"	21.5	22.25	21.75	Normal	12, 13, 12, 13 13, 12, 13, 12	Green l.
12:52	Green.	21	22.25	21.75	Normal	12, 13, 12, 13, 13, 12, 13, 12, 13	After 15 min.
1:00	"	21	22.25	21.75	Normal	13, 13, 14, 13, 14, 14, 13, 12, 13	ether introduced
1:15	"	21	22.25	21.75	Ether.	16, 17, 16, 17, 16, 17, 16, 16, 17, 17	Ether removed.
1:25	"	21	22.25	22	Normal	13, 13, 14, 13, 13, 13, 12, 14, 13	Dark.
1:36	Dark.	21.5	22.5	22	Normal	13, 12, 13, 14, 13, 13, 12, 14, 13	After 30 min.
2:08	"	21.5	22.5	22	Normal	14, 15, 13, 14, 15, 14, 15, 14	ether introduced
2:20	"	21.5	22.5	22	Ether.	16, 17, 19, 18, 19, 17, 18, 18, 19	Ether removed.
2:26	"	21.5	22.5	22	Normal	14, 15, 14, 14, 13, 14, 14, 13, 14	End.

I experimented also with *Fuchsia* and *Geranium* with the results given above. These experiments indicate that the different colors of the spectrum do not affect the influence of ether vapor on plant transpiration.

II. RELATION OF ATMOSPHERIC MOISTURE TO INFLUENCE OF ANÆSTHETICS.

Atmospheric moisture does not affect the influence of ether vapor on transpiration, as the following experiments show. Kohl claims that transpiration is zero in the saturated atmos-

phere. I can not agree with him. Of course any one knows that in a saturated atmosphere moisture can not be given off as vapor. That would be a mechanical impossibility. It is also quite difficult to saturate an atmosphere evenly and completely with moisture. A bell-jar was not equally warm on all sides under the most favorable circumstances I could bring to bear upon it. At no time did transpiration approach zero after all the conditions of the experiment had been properly accounted for. In the following experiments the plant was exposed to diffuse sunlight.

1. *Solanum tuberosum;* small plant, strong roots.

Time	Tempe'ture Air °C.	Tempe'ture Wat'r °C	Condition of atmosphere.	Anæst. or normal	Time, in seconds, required to evaporate 5^{mm} of water column.	Progress.
3:00	24.5	24°	Dry	Normal	7, 8, 7, 7, 8, 7, 7,8,7,8,7,7 8,7,7,7,8	In sat. atm'e
3:04	24.5	24°	Gradu'lly saturat'd	Normal	7,8,7,7 8,8,7,8,8,7,8,8,8,9,8,9,9.....	After 5 min.
3:10	24.5	24°	More saturated.....	Normal	10,10,11,10,11,11,11,12,11,12,13,13	After 10 min.
3:25	24.5	24°	More saturated	Normal	24, 24, 25, 26, 27, 29, 32, 35, 34.....	After 1 hour
4:30	24	23°	Practically satur'td	Normal	34, 36, 35, 36, 34, 32, 36, 37, 35.....	exp'd to ether
4:45	24	23°	Practically satu'td	Ether...	35, 38, 49, 64, 68, 78, 82, 84.....	Eth. remov'd
5:00	21—	22¼°	Practically satur'td	Normal	34, 35, 35, 36, 32, 35, 36, 34, 35.....	End.

2. *Fuchsia* sp. ?; small plant, strong roots, no flowers.

Time	Tem. air. °C	Tem. water °C	Condition of atmosphere.	Anæst. or normal	Time in seconds, required to evaporate 5^{mm} of water column.	Progress.
10:15	21.5°	20°	Dry	Normal	9,8,8,9,8,9,8,8,9,9,8,9,8,9,8,9,8,8	Plant moistened.
10:20	21.5	20	Part. sat'd	Normal	11,11,15,14,15,15,16,16,18,17,18,19	After one hour
11:30	22	21.5	Prac. sat'd.	Normal	32, 31, 33. 31, 30, 33, 31, 32, 30.33	ether introduced.
11:30	22	21.5	Prac. sat'd.	Ether...	60, 66, 64, 67, 70. 68, 70, 74, 78.....	Removed.
12:00	22.5	22	Prac. sat'd.	Normal	30, 31. 32, 30, 32, 31. 32, 30, 31.....	Amyl n. introduced
12:15	22.5	22	Prac. sat'd.	Amyl n.	75, 64, 70, 76, 74, 70, 75, 76, 74, 71	Amyl n. removed.
12:30	22.5	22.5	Prac. sat'd.	Normal	33. 32, 34, 31, 32, 31, 34, 32, 33.....	End.

These experiments showed that moisture did not affect the influence of ether and amyl nitrite vapors on plant transpiration.

IV. Experiments on transpiration of leaflets.

Finally, to show the cause of Jumelle's apparently erroneous conclusions, I made a series of control experiments with *Solanum tuberosum* leaflets. There is no mechanical difficulty in performing these experiments, but they require close observation to avoid mistaken conclusions. The object of these experiments was to find the loss, in weight, of water in potato leaflets exposed to ether vapor in diffuse light and darkness. Jumelle states that he used the "branches" of various

plants in his experiments. Now it is in reality impossible to secure two branches from different plants (same species), or even the same plant, that are in all respects alike as to function and age, and which have been exposed to the same environments during life. To avoid these difficulties I observed the following precautions:

1. *Solanum tuberosum* leaflets were used.
2. Leaflets of the same leaf were used thus securing those of the same age, which had been exposed to the same external environments as nearly as possible.
3. The conditions of temperature and moisture were the same for all leaflets.
4. Only healthy looking leaflets were used.
5. Great care was observed in the handling of leaflets so as not to bruise them.
6. The petiole was cut straight across as near to the midrib as possible.

These leaflets were then weighed and placed on equal sized and seasoned pine blocks to keep them from the colder surface of the ground glass plate on which the blocks were placed. A well-fitting bell-jar was placed over each. Two leaflets were placed under normal bell-jars, two under dark bell-jars, blackened on inside with camphor soot. Two leaflets, one in the dark, the other in diffuse light were exposed to ether vapor evaporating from a flat dish, care being taken to have the same amount of ether in both cases in the same experiment. The following are the results:

1. Time of first exposure of leaflets, $1\frac{1}{2}$ hours.

Condition of light.	Anaesthet. or normal.	Weight in mg. before exposure.	Weight in mg. after exposure.	Loss in mg.	Per ct. loss.
Diffused	Ether	126	117	9	7.14
Diffused	Normal	130	120	10	7.69
Dark	Ether	131	124	7	5.34
Dark	Normal	136	128	8	5.89

The same leaflets were again weighed after having been exposed for 6 hours.

Diffused	Ether	126	58	68	54
Diffused	Normal	130	87	43	33
Dark	Ether	131	71	60	36
Dark	Normal	136	96	40	29

During the first period of exposure the ether had reduced *transpiration* and hence reduced the loss of moisture.

In the second period of exposure the ether had killed all the protoplasm and hence *evaporation* took place and not *transpiration*, which accounts for the increased loss in weight.

2. Time of first exposure, $\frac{1}{2}$ hour.

Condition of light.	Anaesthetic or normal.	Weight in mg. before exposure.	Weight in mg. after exposure.	Loss in mg.	Loss per ct.
Diffused	Ether	51	50	1	1.9
Diffused	Normal	75	70	5	6.6

Conclusion: Ether retards transpiration in diffused light.

3. Time of exposure, $1\frac{1}{2}$ hours.

Diffused light.	Ether	236	223	13	5.5
Diffused light.	Normal	203	191	12	5.9

Conclusion: Ether retards transpiration in diffused light.

4. Time, $\frac{2}{3}$ hour.

Diffused light.	Ether	45	43	2	4.4
Diffused light.	Normal	57	54	3	5.2
Darkness	Ether	47	45	2	4.2
Darkness	Normal	32	30.5	1.5	4.7

Same leaflets weighed after 3 hours.

Diffused light.	Ether	45	34	11	26.6
Diffused light.	Normal	57	45	12	21
Darkness	Ether	47	35	12	25.5
Darkness	Normal	32	26	6	18.7

Conclusion: Ether retards transpiration in diffused light.

5. Time of exposure, $3\frac{1}{2}$ hours.

Diffused light.	Ether	90	67	23	25.4
Diffused light.	Normal	75	56	19	25.25
Dark	Ether	84	57	27	32
Dark	Normal	93	74	19	20.43

Conclusion: Owing to the long period of exposure the ether had stopped protoplasmic activities, and hence increased evaporation in both cases, but most in the dark, because leaflets in the dark were killed first.

6. Time of exposure 1 hour.

Diffused light.	Ether.....	64	57	7	10.9
Diffused light.	Normal.....	57	61	7	12.2
Dark.....	Ether.....	68	61	7	10.2
Dark.....	Normal.....	48	43	5	10.4

Conclusion: Ether retards *transpiration* in both light and dark.

V. Summary.

1. Ether retards protoplasmic action. Given in sufficient dose it kills protoplasm.

2. Ether retards transpiration by retarding assimilation.

3. Anything that retards assimilation will retard transpiration.

4. Increased loss of water vapor in the anæsthetized vegetable tissue is due to the fact that the anæsthetic has killed the plant tissue, thus allowing *evaporation* to take place, and not *transpiration*.

5. Ether retards transpiration under all conditions.

6. Transpiration is not essentially a chlorophyllian function.

7. Experiments in which the entire plant is not used are practically valueless.

8. Periods of maximum growth and maximum transpiration coincide.

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University of Minnesota.

EXPLANATION OF PLATE VI.

a, stand made of well seasoned heavy oak. All the wood work is thoroughly soaked in hot paraffine to make it impervious to water.
b, a glass tube filled with water in which is placed the root of the plant experimented upon.
c, block of wood to hold *b* in its place.
d, rubber stopper fitting into *b*, with two openings, one for bent glass tube connected with *e* and the other for bent glass tube connected with *v*.
e, rubber tube connecting glass tube *g* with bent tube in *d*.
f, bent glass tube connected with capillary tube *h*.
g, glass tube closed at distal end. This is to regulate the position of the water column in *h*.
h, fine capillary tube connected with *f* and from which the observations are made.
i, heavy glass plate with ground surface.
j, glass tube passing through opening in *i* and wood work, connected with *z*.
j', rubber stopper in upper end of *b*, perforated to admit stem of plant experimented upon. An incision is made from surface to central perforation to admit plant.
k, bell jar.
l, rubber stopper, with two openings.
m, thermometer to register temperature of atmosphere in *k*.
n, bent glass tube to give exit to atmosphere.
o, sulphuric acid bottle to dry atmosphere before it is passed through *k*.
p, calcium chloride tube to assist in drying air.
q, rubber tube connected with *o* and an aspirator, hand- or foot-bellows.
r, small vessel containing water to be taken up by *h* when no observations are made.
s, metric scale on which to observe the rate of movement of water column in *h* while transpiration is going on.
t, an ordinary Mælzel metronome regulated to beat seconds to assist in making observations.
u, clamps to hold block *c* firmly in place.
v, small rubber tube to connect *f* with *h*.
w, perforated stoppers to hold a small thermometer in place. Above upper stopper should be placed a little cotton to act as a fitter to prevent sand, dirt, etc., from getting into *h*.
x, clamps to hold *p* in place.
y, rubber tube connecting *o* with *p*.
z, rubber tube connecting *p* with *j*.

Root in tube *b* is to be protected against direct sunlight and sudden changes of temperature by means of a black silk cloth and heavy pasteboard shields. Slight changes of temperature have but little effect on water because its coefficient of expansion is comparatively low. Bubbles of gas, however small, are very susceptible to changes of temperature, and make their presence known by the fluctuations of the water column in tube *h*.

BRIEFER ARTICLES.

Notes on a variety of Ampelopsis quinquefolia.—For the past ten years I have been observing a variety of the Virginia creeper that is quite marked by characteristic points of difference from the type species. Other students of botany must have noticed this variation and it is strange if nothing has been published upon the subject, but thus far I have failed to find anything[1]. My attention was first called to the variation by neighbors who had transplanted the Virginia creeper from the woods but complained that it failed to cling to the side of the house. That was in the Miami valley in Ohio. I have since observed it in southern Iowa and in eastern Kansas. It does seem to me that the peculiarities are sufficient to distinguish it as a permanent variety and it should be so recognized in our manuals.

In the first place the habit of growth is quite different from the type species. As is well known this latter climbs by clinging very closely to its support whether that be a tree or a wall. The variety does not cling so closely to its support. In fact it is impossible for it to climb a wall or even a tree unless the bark be very rough, owing to the structure of its tendrils. It climbs more like the grape and the clematis by trailing over low shrubbery to that which is higher, until it may reach the lower branches of a tree when it may rise to a considerable height by reaching from branch to branch rather than by clinging close to the body of the tree and larger branches.

Sometimes in transplanting the Virginia creeper this variety is hit upon and the unobserving wonder why it fails to cling to the side of the house. On examination the tendrils will be found to be more like grape tendrils, long curling and grasping by recurved tips, rather than short, digitate and clinging by disk-like expansions as in the case of the typical species. The leaves also differ quite perceptibly, being much larger for the same age in the variation, and having longer petioles both for the leaf proper and for the leaflets. The margins are more distinctly serrate with larger teeth. The internodes of the stem are much longer in the variety, causing the leaves to be fewer and more scattered. The nodes are more swollen as are the leaf petioles at the base, making a much larger leaf scar, but the axillary buds are smaller.

The stem of the type species is quite rough, furrowed and warty, especially as it grows older, while the variety is much smoother. The fruit of the variety is more abundant, berries larger and in more open corymbs.

[1] [See W. R. Lazenby in this journal XIII. 233 and XV. 233.—EDS.]

In short the whole aspect of the variety is more grape-like and for this reason I suggest the name *A. quinquefolia*, var. **vitacea.**—E. B. KNERR, *Midland College, Atchison, Kansas.*

Miscellaneous notes.—In May, 1892, I collected specimens of *Oxalis acetosella* L. having the whole blossom the same reddish color that usually veins the petals. These specimens were found in only one place on the western side of the Green mountains, just east of Manchester, Vermont.

I have found *Hypericum Canadense* L. var. *majus* Gray, very abundant in southern Vermont.

I have found Vermont specimens of *Scutellaria lateriflora* L. to be slightly pubescent as a rule. The corolla of my Vermont specimens of *Stachys aspera* is also slightly pubescent.

Prof. Burrill in the Bulletin of the Illinois State Laboratory of Natural History, II, 408, describes the Illinois specimens of *Uncinula circinata* C. & P. as "hypophyllous." In Vermont specimens I find that quite a percentage of diseased leaves have the fungus on the upper as well as the under side. In the same article, p. 419, he says of *Microsphæra crineophila* Peck: "This peculiar species is not uncommon in southern Illinois. So far as is known it has not been collected elsewhere." I had the good fortune to find a very limited amount of the above mentioned fungus in Newfane, Windham co., Vermont, in October, 1892.

I have found a few parasitic fungi on hosts not in Farlow & Seymour's "Host Index." *Phylactinia suffulta* (Reb.) Sacc. seems to have no choice of hosts whatever, provided that moisture and a little nourishment be furnished. I found it on the following additional hosts: Hamamelis Virginiana, Fraxinus Americana, Betula lutea, Alnus incana. On September 23, 1892, I placed specimens of *Phylactinia suffulta*, found on leaves of Fraxinus Americana, in a book to dry. There were so many specimens in the book that they kept it moist most of the time and I neglected to thoroughly dry it for nearly three weeks. On October 13th I found nearly mature perithecia of Phylactinia suffulta scattered all over the pages of the book and the label, which I had placed with the specimens. By applying KOH to the paper and scraping, threads of mycelium were obtained, showing that the fungus had grown on the damp paper. The asci were formed at the time I examined the plant but no spores. A similar thing took place with another set of P. suffulta specimens that were kept slightly moist for a time.

Microsphaera Alni (DC.) Winter was collected in Newfane, Vermont, on Betula lutea and Ostrya Virginica. *Uromyces Hyperici* was found in

the same locality on Hypericum Canadense var. majus.—A. J. GROUT, *Johnson, Vermont.*

EDITORIAL.

Of the new fields of botanical research developed in the last few years none have shown more rapid extension and greater economic importance than the study of that class of plant diseases due to parasitic bacteria. The first instance of such a disease was brought to notice in 1880 by Burrill, of Illinois. The disease of pomaceous trees, the cause of which he discovered, best known under the name of pear blight, remains at the present time the most fully investigated disease of its class.

In 1884 DeBary published his work entitled Morphologie und Biologie der Pilze, Mycetozoen und Bacterien, and in a brief paragraph on bacterial parasites of plants says they have scarcely been observed, and offers the suggestion that the acidity of the cell sap may partially explain their rarity. Probably no mention of the matter would have been made if the account of the yellow disease of hyacinths, with which bacteria are concerned, and which Wakker brought to light the preceding year, had not come to DeBary's attention.

In 1887 DeBary published his lectures on bacteria, which still remains one of the best works we possess on the general biology of this group of organisms. In this work he gave several paragraphs to the subject, mentioning the two diseases already named, and two or three other doubtful kinds, and appears to hold the view that in no case is the actual parasitic nature of bacteria established, so far as vegetable hosts are concerned. He closes the subject, and at the same time his series of lectures, with the statement that "bacteria are not objects of great importance as contagia of diseases affecting plants." This was the opinion of the best informed writer six years ago, and it has not been modified in any general treatise since that time.

Within the last six years, however, the number of discoveries in this line have been astonishingly large, and it is now evident that it has not been so much the scarcity of the diseases as the scarcity of the right kind of investigators, which has kept the subject obscure. The diseases have been all about us, but they have not been recognized.

The larger part of the advance so far made is due to American activity. Well defined diseases of tomatoes, potatoes, melons, oats, corn, sorghum, beans, beets, carnations, violets, pears and apples, and possibly others, are already known, and still more have been suggested as probably of bacterial origin.

Such diseases are often of the most virulent and destructive character, as pear blight and tomato blight; or they are wide spread and exceedingly harmful by decreasing the yield, although not killing the plant or producing marked changes in it, as the bacterial disease of oats. This latter class is not recognized as disease by the cultivator.

The literature of this subject is much scattered, and unusually fragmentary. Few of the diseases have been systematically investigated, and not one has been fully worked out. The life history of the parasite in every case still demands attention, and even the nature of the parasitism itself would be a fruitful field for study. Nevertheless, were what is already known of the subject put together, it would form a fair sized volume.

There can be little doubt that what has so far been discovered is but a beginning. The results are likely to be eventually quite as extensive and important as in animal pathology, except in so far as the latter directly affects or coincides with human pathology.

What is especially needed at this stage of advancement is the continuous and systematic examination of the whole ground by one or more well equipped investigators, and the publication of a critical statement of what may be safely accepted as proven. Even a summarization of the present status of the subject, without critical laboratory study, would be helpful, if well done.

CURRENT LITERATURE.

Biology in an attractive form.

Gibson's recently published work, which he has called "Sharp Eyes,"[1] is an admirable piece of book making, from whatever point of view considered. The work conveys much interesting, curious and useful information about plants and animals, is written in choice language, in direct narrative style, and of high literary quality, and is profusely illustrated with spirited glimpses of nature, most delicately and artistically drawn.

The author has, indeed, "sharp eyes," not only to see small objects, but to penetrate their meaning. He looked at "things not rare, nor seclusive, nor foreign, things which are to be found in almost any of our woods, or fields, or copses; and which any wide-awake saunterer

[1] GIBSON, WM. HAMILTON.—Sharp Eyes, a rambler's calendar of fifty-two weeks among insects, birds and flowers. Roy. 8vo. Harper & Brothers, New York, 1892. pp. 322. Illust. $5.00.

may discern." Every chapter is filled with interesting matters about these common objects, which will be largely new to the reader, whether young or old.

The author is equally familiar with the peculiarities and habits of flies, wasps, toads, squirrels, flowers, germinating seeds, pine cones, exploding pods, sleeping leaves, etc., and he studies them not as animals or plants, but as natural objects having an interesting history and curious behavior.

There is a division of the work for each week in the year, beginning with March. The first chapter deals with the flowers of the skunk-cabbage, the next with the behavior of maple seeds, the next with Pickering's frog, then antics of opening cones, and the ingenuity of squirrels, and so on for the fifty-two divisions.

Although the author writes popularly and mainly for young people, he does not sacrifice accuracy, and often supplies the Latin names when the common ones do not suffice for identification. Among the fungi only does he appear wanting in scientific information, e. g., regarding fairy rings and the exobasidium excrescences on Azalea.

But the best feature of this work is yet to be mentioned. There is an atmosphere pervading its every line that makes the reader feel that the chief advantage is to be gained by hunting up these and similar curious things himself. Herein the author has rendered a distinctively scientific service to biology. If boys and girls were trained in biology and biological methods of this kind, the oft made remark that the botany and zoology which a pupil knows when he comes to college are usually hindrances to his further progress in those studies would no longer be true, and much of the effort of the college teacher in training young men and women for investigators would be uncalled for.

A text-book of botany for pharmacy students.[1]

In this new text-book we have no decided departure from previous ones. It is, however, a compact and well balanced presentation of the facts of botany which it is most important for students of medicine and pharmacy to know. If any criticism upon the balance of parts is to be made, there seems to us too much space devoted to the presentation of the classification of plants; but perhaps, considering the predominant place which this part of the subject has always held in the instruction imparted to such students, this book makes as great an advance as ought to be expected. For only one-third of the space is so used,

[1] WARNE:KE HERMANN:— Lehrbuch der Botanik für Pharmaceuten und Mediciner; Einführung in das Studium der Pharmakognosie des Pflanzenreiches. 8vo. pp. xii. 364. figs. 338. Braunschweig: Harald Bruhn. 1892.

and much of the morphology is really found in this section. The preceding 226 pages are devoted to an exposition of the external morphology of plants; an introduction to microscopic technique and vegetable anatomy; and an account of the structure of some of the more important drugs.

The morphology of the vegetative organs of the lower plants is dismissed with a few pages, a treatment which is only justifiable in consideration of the small part these plants play in medicine. Even from this point of view, it might well have been longer; what there is is good. The discussion of the morphology of the members of the higher plants is a compact and clear presentation of, for the most part, modern ideas, with comparatively few survivals of useless terminology. We cannot say so much for the account of the morphology of the flower of angiosperms in the systematic part, where Dr. Warnecke does not seem to be so much in touch with modern conceptions.

The section on anatomy (leaving out of the special anatomy of the selected drugs, regarding which we are not competent to express an opinion) is again a well selected and well arranged compendium of the elements of histology. Dr. Warnecke has shown good judgment in what he has put in and what he has left out. The treatment of secondary thickening, for example, so important for an understanding of the structure of most of the barks, stems, rhizomes and roots which come into use as drugs, is full and yet concise, though we do not approve of the way in which it is distributed amidst the special descriptions of these parts.

The illustrations throughout are for the most part original, sometimes too mathematical, but are excellently engraved and printed. The book really deserves translation into English for American students.

Minor Notices.

Bulletin 45 of the Cornell University Agricultural Experiment Station treats of the cultivation of tomatoes. Bulletin 46 of the same station gives an account of the cultivated forms of mulberries and their specific relations. Sixteen varieties are mentioned as fruit bearing, of which the New American is recommended. These sixteen varieties belong to five more or less distinct general types or species, Morus alba, M. latifolia, M. Japonica, M. nigra, and M. rubra. The latter, our native species, Professor Bailey looks upon as the probable progenitor of the American mulberries of the future.

In its bearing on the feeding of plants, investigation of the physics of the soil is of prime importance. Those who are interested in plant physiology should therefore take note of the recent work of F. H.

King, Professor of agricultural physics in the University and Physicist of the Wisconsin Agricultural Experiment Station.[1] For a considerable time Professor King has been studying the effect of various superficial causes upon the level of the water in the interstices of the soil. He has not only discovered a number of curious variations in this "water table," but has devised several ingenious pieces of apparatus for studying the complicated problems which presented themselves, and has been able to ascertain many of the relations between barometric pressure, rain-fall, temperature, seismic vibrations, cropping, manuring, etc., and the level of the ground-water. For details we must refer our readers to the papers themselves.

THE LIST OF mosses included in the catalogue of the flora of West Virginia by Millspaugh (see this journal XVIII, 34) has been separately issued as Contribution No. 32, from the Herbarium of Columbia College. Two new species of Dicranodontium are described, with excellent plates, *D. Virginicum* and *D. Millspaughii*. The latter is *Campylopus flexuosus* Sull. (non Brid.). Eighty-four species and varieties are enumerated.

A. S. HITCHCOCK, Professor of botany in the State Agricultural College of Kansas, has issued a useful descriptive list of the species and key to the genera of the "Woody Plants of Manhattan in their Winter Condition."[2] The list contains sixty-three native and four commonly cultivated species that have escaped. It was prepared originally for the use of the author's students. The nomenclature follows the Rochester agreement, and the sequence that of Gray's Manual.

OPEN LETTERS.

Is Polyporus carnivorous?

The article in the November GAZETTE entitled, "*A probable new category of carnivorous plants*," was read with much interest, although it seems to me that there should be considerable hesitation in accepting Prof. MacMillan's interpretations of the facts, for the following reasons:

1. The flies frequently found on the under surface of *Polyporus applanatus* do not seem to be there from any special preference for the

[1] KING, F. H.:—Investigations relating to soil moisture. Extracted from the eighth annual report of the Wis. Ag. Exp. Sta., pp. 91-134. Also: Observations and experiments on the fluctuations in the level and rate of movement of ground-water on the Wis. Agric. Exp. Sta. farm and at Whitewater, Wis. U. S. Dep't of Agric., Weather Bureau, bulletin No. 5. Washington, 1892.

[2] Copyrighted and published by the author, Manhattan, Kansas. 8vo. pp. 20.

fungus, but are evidently searching for roosting-places, and may be found in equal numbers on the under surfaces of logs raised from the ground or in any sheltered nooks. Professor MacMillan has noticed that the flies are more abundant, "notably in the evening or toward the middle of the afternoon," and also says, "I have not been able to discover any secretion that might be attractive to the insects given off by the plant, but there may be such."

2. It is not evident that the fungus either catches or kills the flies. Searching for Myxomycetes and Hepaticæ has led me to notice more particularly the fact that small dead flies and other insects are sometimes very abundant in the roosting-places mentioned above, wherever they can hang suspended from a horizontal surface, the position apparently most restful to the insect anatomy, and where the feebler individuals die from cold in t e night. How flies with their feet caught in the pores of a *Polyporus* come to lie "flat upon the hymenophore surface," is not plain. One would expect them to hang suspended by their legs, which is usually their position.

3. The fact that the dead insect is soon overgrown by hyphæ of the fungus does not bear directly upon the question, for the growing hymenophore of species of *Polyporus* will spread itself upon almost any foreign body with which it happens to come in contact. When a growing specimen of *P. applanatus* meets with a stem of a living herbaceous plant it spreads over the surface of the latter, and finally encloses it, so that the stem occupies a cylindrical passage up through the fungus. The borders of the lower end of this hole are extended downward along the plant stem, sometimes for a considerable distance below the general plane of the under surface of the specimen. When the foreign body is of small size it is soon completely enclosed in the substance of the fungus. On railroad ties fungi frequently have both upper and lower surfaces covered with elevations and protuberances like those described by Prof. MacMillan, which on investigation may be seen to inclose small bits of coal and cinders. On cutting through such a specimen similar pieces of mineral matter may be found anywhere in its substance.

That the projections formed over the dead flies is white like the growing borders of the hymenophore is very probably due to the fact that in both places the hyphæ are more flocculent, and less closely matted together.

4. That the remains of the insect are not a lasting impediment to the formation of pores does not necessarily imply digestion, for when a small fly has died and dried up, very little solid matter remains to impede anything. In the case where solid particles are enclosed by the fungus a thick layer of hymenophorous tissue is put on, and pores are formed in this just as though no foreign substance were present above them. The parts of the dead fly are ramified and encased by the filaments of the fungus, and when these last arrange themselves to form the usual porous structure it would not be strange if the fly were lost to sight.

5. To say, "It is unquestionably true that the plant derives some nutriment from these flies, for where they fall and raise the surface of the hymenium there are more pores produced than at other points of similar size," appears, to say the least, unwarrantable in view of the

fact, above stated, that the surface, and consequently the number of pores, is increased when the growing hymenophore comes in contact with foreign substances which are not and cannot be digested by the fungus.

It is not intended above to maintain that *Polyporus applanatus* does not digest and get nutriment from the small dead flies, but that the methods of growth of this and allied species are such that the reasons enumerated in Professor MacMillan's article do not seem sufficient to warrant the inference of a carnivorous habit.

There is, however, a fact suggesting that the hyphæ of the fruiting body of *Polyporus* are sufficiently different from those of the vegetative portion not to be concerned with nutrition or digestion. When two logs lie within a few inches of each other and a sporophore of *Polyporus applanatus* grows out of one log and across to the other, it may spread itself out somewhat upon the latter, but its hyphæ do not seem to penetrate, even in cases where the logs are of the same species and in the same stage of decay. Again, a rotten leaf plastered against the growing hymenophore seems to be a serious obstacle to growth. Instead of sending in hyphæ and digesting the leaf, the latter is covered from the edges as any perfectly indigestible substance would be, or if the leaf be too large the growth of the portion covered is abandoned. And yet, *a priori* reasoning would lead us to suppose that a rotten leaf would be more readily dealt with than a fly, being more nearly like the usual food of the fungus.

Indeed, the very fact that the species of parasitic and saprophytic fungi show such decided preference for certain hosts is an important reason for doubting that *Polyporus applanatus* makes active use of animal nourishment.—O. F. Cook, *Huntington, N. Y.*

NOTES AND NEWS.

Garden and Forest says that the tallest trees in the world are in the gullies of Victoria, one of which is 471 feet high.

Beloit College has recently dedicated a new building known as Pearsons' Hall of Science, in which admirably arranged botanical laboratories find a conspicuous place.

Dr. William Trimen, director of the Royal Botanical Gardens of Ceylon, is preparing a "Handbook to the Flora of Ceylon," which will be issued soon by Dulau & Co., London.

Jars containing the tubercle-bearing roots of about forty species of North Dakota Leguminosæ will be shown at the World's Fair by Prof. H. L. Bolley, of the State University at Fargo.

The botanical seminar of the University of Nebraska has organized an exchange club for the purpose of facilitating exchanges among collectors in Nebraska and rendering them more satisfactory.

The monumental work by Engler and Prantl, entitled "Die Natürlichen Pflanzenfamilien" will be specially displayed at the World's Fair in Chicago, by the publisher, W. Engelmann of Leipzig.

THE COLORED PLATE of Opuntia prolifera in the January number of *Meehan's Monthly* is one of the handsomest that has yet appeared in that journal, and is accompanied by an unusually interesting description of the plant.

A BACTERIAL DISEASE of beans is figured and briefly described by Prof. B. D. Halsted in *Garden and Forest* for December (v. 620). It forms blotches upon the pods, and also attacks the leaves. Seed beans may be sufficiently affected to prevent their germination.

PUCCINIA AGROPYRI, a common American species of rust, has now been found in southern Europe by Dr. P. Dietel (*Hedwigia*, 1892), who has also found by culture experiments that it is genetically connected with Æcidium Clematidis, also common in America as well as in Europe.

BRADLEY M. DAVIS has filled up the gap in our knowledge of the life history of *Champia parvula* by tracing the development from the spore to a stage identical with the mature condition. Previous investigations by Debray and Bigelow have elucidated the structure of the adult frond.

DR. J. H. SANDBERG, of Minneapolis, invites the co-operation of botanists in the establishment of a botanical exchange bureau. The Botanical Division of the Department of Agriculture has decided, after consulting the members, to turn over to him the work of the Botanical Exchange Club.

M. HENRI HUA has begun in *Journal de Botanique* (Nov. 1) an enumeration of the Chinese species of *Polygonatum*, which represent half the known species. Recent explorations by M. l'abbé Delavay and MM. Farges, Soulié and Pratt, have brought to light 16 new species, making the enumeration for China reach 22.

J. CHRISTIAN BAY, a young Danish botanist now in the employ of the Missouri Botanical Garden, has been asked by the editors to review current literature of vegetable physiology for the Botanisches Centraiblatt. The authors of papers dealing with vegetable physiology are requested to send copies to the library of the Garden, at St. Louis.

AT A RECENT MEETING (Nov. 3rd) of the Linnean Society, Mr. C. T. Druery exhibited some new examples of apospory in ferns, namely, a specimen of *Athyrium filix-fœmina*, var. *clarissima*, with pinnæ showing development of prothallia by soral apospory, and a seedling, *Lastræa pseudo-mas cristata*, showing prothallia developed asporously over the general surface of the frond (pan-apospory).—*Gard. Chron.*

A NEW BOTANICAL JOURNAL was announced to appear in January under the title "Bulletin de l'Herbier Boissier," and will be published at Chambésy, near Geneva, under the direction of M. Eugène Autran, curator of the Boissier Herbarium. It will contain original papers, notes, etc., upon general systematic botany, and is promised to form yearly a stout octavo volume with plates. The price is 12 francs a year.

THE COMPILATION of the systematic and alphabetic index of new species of North American phanerogams and pteridophytes published in 1892, is now in preparation at the U. S. National Herbarium.

The index will be more nearly complete and published at an earlier date, if all botanists will promptly send to Dr. Vasey, Chief of the Botanical Division, their recent monographs and reprints of articles in botanical works.

In a study of regermination of seed Mr. A. M. Ten Eyck has found (*Agric. Science* VI, 454) that wheat will germinate fourteen times, after an interval each time of seven days drying at ordinary temperature. Corn gave six such germinations, radish five, parsnip and carrot two, and celery, clover and pansy one. It was also found that the seeds of any lot which germinated quickest were strongest and could withstand more drying. See also this journal, XVII, 230.

M. Jules Cardot has begun in the fifth and sixth numbers (double) of the *Revue Bryologique* for 1892 a list of all the species of mosses now known from North America, showing their geographical distribution. The list is not critical, including all the species of Lesquereux & James' Manual and all new species described since its publication, except in the case of evident duplication. Enumerated in this way (useful at present, but obviously an overestimate) our bryologic flora contains about 1350 species.

The botanical papers read at the meeting of the Iowa Academy of Sciences, Dec. 27th and 28th, were: On the absence of ferns between Ft. Collins and Meeker, Col., by *F. M. Witter;* Phenological notes for 1892, Relation of frost to certain plants, Notes on the flora of Texas, and Pollination of cucurbits, by *L. H. Pammel;* Palisade cells and stomata of leaves, and A key for the identification of weed seeds in clover, by *F. C. Stewart;* and Notes on the flora of Muscatine, by *Fred. Reppert.* The Academy will hereafter have its proceedings published by the State.

A description of last season's botanical work in Idaho, done by J. H. Sandberg, A. A. Heller and D. T. MacDougal, the party sent out under the auspices of the Botanical Division of the U. S. Department of Agriculture, appears in *Science* for Dec. 2, 1892, written by Mr. MacDougal. The north-central portions of Idaho were traversed, a region almost wholly unknown botanically heretofore. About 25,000 herbarium specimens, mostly phanerogams, embracing nearly a thousand species, were obtained, together with much valuable biological and geographical information pertaining to the vegetation of the region.

A noteworthy and commendable undertaking is that of a botanical survey of Nebraska, to be conducted by the Botanical Seminar of the State University. It is a private enterprise, to be paid for by the members of the Seminar, whose devotion in this respect cannot be too highly commended. Being private, the work can be purely scientific, and so of vastly greater interest to the botanical public. We look for results commensurate with the energy shown in the organization. A preliminary circular announcing the organization and its purpose has been issued, and from its tone it may be inferred that the work is not only to be prosecuted vigorously, but that the form of its publication will be as modern as the knowledge of the Seminar can make it. Mr. Albert F. Woods is the secretary.

THE LEAVES AND FLOWERS OF MILFOIL, or yarrow (*Achillea Millefolium*), inebriate, and were used by the Dalecarlians in Sweden to render their beer intoxicating. Clary (*Salvia Sclarea*) and saffron have also been used for this purpose. The last exhilarates the spirits to such a degree that, when taken in large doses, it occasions immoderate mirth and laughter. Darnel (*Lolium temulentum*), which is vulgarly known in England under the name of sturdy, when malted with barley, causes the ale brewed from it to be speedily intoxicating. Among the many different inebriants, the inspissated milky juice of the common garden lettuce is considered as powerful in its operation as opium itself.—LOUIS PIO in *Am. Brewer's Rev.* VI. 315.

BOTANICAL WORK is being prosecuted to a greater or less extent at thirty-two stations in the United States, as shown by statistics gathered by Prof. Atkinson and recently published in *Science*. The study of fungus and bacterial diseases and of their treatment is the subject receiving most consideration. Some give attention to systematic botany in the study of the native flora, a few are investigating the life history of certain fungi, and a few carry on physiological work. At some stations the botanist's duties do not materially differ from those usually performed by a horticulturist. On the whole the results of botanical efforts at the stations are commendable. They are certainly not behind the results displayed by the other departments of the stations.

MR. A. LASCHE CALLS ATTENTION (Am. Brewer's Rev. IV. 305) to the doubtful value of the results obtained by Dr. H. Moeller (Centr. f. Bak. u. Par. XII. 537) in the study of the spores of yeast. Dr. Moeller arrived at the conclusion that yeast has no true spores, that the so-called spores are without cell-wall or nucleus, and are incapable of germination. Mr. Lasché points out that the method used by the investigator would rarely result in spore formation, and that his photograms alone demonstrate that he obtained no true spores for study. Mr. Lasché's exceptions are certainly well taken, and it is strange how a lengthy, illustrated paper (14 pp., 1 pl.) with such sweeping generalizations, based upon such faulty observation, could find place in a high-class journal.

A LABORATORY for the study of plant diseases has recently been fitted up in connection with the agricultural experiment station of the University of California, at Berkeley. A description of it with plans is given by Mr. C. W. Woodworth in a recent number of *Science* (XX 368), from which we learn that it consists of a room about twenty by thirty feet from which a corner is partitioned off for a private laboratory. There is also a small photographic dark room. The fittings consist of suitable tables, desks, shelves, etc., together with microscopes, microtomes and imbedding apparatus. Provision is made for cabinets of slides, herbarium specimens and pathological samples. The subject is approached from the entomological side, which probably accounts for the fact that while an improved insect box is described nothing is said of apparatus for the cultivation of fungi and bacteria.

PROFESSOR CARRUTHERS' report of the Department of Botany of the British Museum for 1891, appears in the *Journal of Botany* for December (1892). During the year 41,875 specimens have been placed in the herbarium, most of them being collections of oriental plants. It is

reported that the DeBary slides have been arranged in systematic order. "The medium originally employed in mounting the preparations having been insufficiently secured, every slide has been carefully examined, resealed, and, wherever necessary, the specimen has been remounted." The William Smith typical collection of British *Diatomaceæ*, illustrating his standard work, has been added to by the mounting of much unmounted material. Triana's study set of New Grenada plants, which has formed the basis of his publications, is one of the notable additions of the year, as is also the Ravenel collection of N. Am. cryptogams, consisting of more than 14,550 specimens, and including all the species which were described from his material by Berkeley and others.

THE FIRST FASCICLE of "Grasses and Grass-like Plants" issued by A. B. Seymour, of Harvard University, is the beginning of what promises to be a valuable aid to workers among such plants. The fascicle issued contains rushes and sedges, as well as true grasses, and illustrates a wide range of genera as well as of localities, and of the more variable species two or more specimens are given showing extreme as well as typical forms. Each specimen has been compared with others of the same species in the Gray herbarium, or has been determined by some recognized authority whose name appears on the accompanying label. The labels also give references to various government and station publications regarding the economic importance of the species. The specimens are of standard size, and usually well preserved.

The want of authentic specimens for comparison has been deeply felt by all agrostologists, especially by those who are connected with the experiment stations, and we are glad to know that Mr. Seymour intends to continue his distributions until all the more important species have been illustrated.—S. M. T.

THE BOTANICAL PAPERS presented at the eighth annual meeting (Dec. 28th and 29th) of the Indiana Academy of Science are as follows: Notes on the reproduction and development of Grinnellia Americana Harv., *M. A. Brannon;* Some effects of mutilation on forms of leaf and sex of Morus alba and M. nigra, *A. N. Somers;* Botanical field work in W. Idaho, and How a tendril coils, *D. T. MacDougal;* The application of mathematics in botany, and An auxanometer for the registration of growth of stems in thickness, *Katharine E. Golden;* On the fertilization and development of the embryo in Senecio aureus, and The apical growth of the thallus of Fucus vesiculosus, *D. M. Mottier;* Distribution of the N. Am. Cactaceæ, *John M. Coulter;* Marchantia polymorpha not a typical or representative liverwort, A state biological survey, and The need of a large library of references in cryptogamic botany in Indiana, *L. M. Underwood;* Forestry exhibit of Indiana at the Columbian exposition, Notes on the flora of the Chilhowee and Great Smoky Mts., and Additional facts regarding forest distribution in Indiana, *Stanley Coulter;* Notes concerning certain plants of the S. W. counties of Ind., and The "Lilly Herbarium" and its work, *John S. Wright;* Spines and epidermis of cactaceæ, *E. B. Uline;* Preliminary notes on the genus Cactus, *E. M. Fisher;* Some causes acting physiologically toward the destruction of trees in cities, and Botanical assemblies in the U. S. announced for 1893, *J. C. Ar-*

thur; Symbiosis in Orchidaceæ, and The genus Corallorhiza, *M. B. Thomas;* Development of ovule in Aster and Solidago, *G. W. Martin;* Notes on root tubercles of indigenous and exotic legumes in virgin soil of the northwest, *H. L. Bolley.*

In the *Kew Bulletin* for December there is a very interesting paper upon the disappearance of desert plants in Egypt. It relates to the causes of the disappearance of the arboreal desert vegetation of Egypt within historic times, being an extract from the report of the expedition despatched by the Khedive in 1891 to the country between the Nile and the Red Sea. Conclusive evidence is first advanced of the former abundance of an arboreal desert vegetation in comparatively recent times, and the cause of its disappearance is summed up as follows: "To sum up all the facts which I have urged in the preceding pages, it seems clear that in the camel, nature has created a Frankenstein which in this country is gradually devouring her. And it seems that what is applicable to this country is applicable to all countries where soil and climate are fit to produce wild shrubs but not fit to support cultivation. It seems that nature is being slowly but surely beaten by the camel and his inevitable but improvident companion, the axe. Nature fights hard. This year copious rains have fallen in the mountains, but the reply of the Arab is to send for grazing a correspondingly larger number of camels." The same case is called on to explain the disappearance of frankincense and spices from S. Arabia, and of the former abundant vegetation of Palestine which could support a population and herds out of all proportion to its present circumstances. In fact the Arabs in Palestine say that there were formerly lions there, but they were frightened away by the camel. "It is probable that the camel has expelled the lion from Palestine, not by roaring, but by consuming the shrubs which supported the lion's prey."

From advance sheets of the fourth annual report of the Director of the Missouri Botanical Garden we gather the following:

The number of visitors to the grounds through the past year has been considerably increased as compared with preceding years.

A marked improvemen has been made this year in opening up the eastern side of the garden proper, which has been densely shaded heretofore by overgrown shrubbery. This has permitted the conversion of a large tract of bare ground into lawn. The decorative plants, which have been increased considerably in number notwithstanding this seeming extension of the lawn area, have been grouped in clusters instead of being arranged as heretofore in long monotonous rows of a single species, and the number of species in cultivation has been greatly increased by gifts and purchases, and the Director was able to secure from the dry district of Texas, Arizona and California a number of representatives of the more characteristic yuccas, agaves and cacti.

The chief additions to the herbarium have consisted of the current American collections, about 3,000 duplicates from the herbarium of the late John Ball, and a set of some 1,200 New Zealand plants, purchased; and a set of the valuable Exsiccatæ of the Austrian flora, donated by the Vienna Museum. The herbarium, as now arranged, is composed of about 16,000 specimens of thallophytes and 187,000 of other plants.

It has not been found practicable to add to the library as freely as could have been wished, but during the year about $1,427 was spent for purchases and binding. A much needed card index to the species of plants described and figured in works at the Garden has been begun.

An enumeration of the present contents of the library shows 5,225 books, appraised at $19,300, 6,280 pamphlets, appraised at $1,850; giving a total valuation of $21,150.

Dr. Sturtevant has donated his entire botanical library, including the scrap books of his own writings and his manuscript notes on edible plants, with the privilege of retaining the books during his life, or so long as he may have occasion to use them. The library presented in this manner by Dr. Sturtevant is undoubtedly the most complete and valuable American collection of pre-Linnæan botanical books, and represents the expenditure of a great amount of time and money on his part, since he has for many years been interested in bringing together the early literature of the science, especially in its application to economic plants. In accepting this generous and quite unsolicited gift, the Board of Trustees of the Garden at their November meeting expressed their appreciation of its value and of the spirit in which it was tendered, and voted that on its actual receipt at the Garden it should be arranged, together with other works published prior to the time of Linnæus, in a separate alcove, the whole to be known as the E. Lewis Sturtevant library of pre-Linnæan botany. Whenever this alcove shall be opened, a catalog e of its contents will be published, in order that students of botany may know where a collection of books of this character can be consulted.

In the early part of the year, Dr. Sturtevant also donated to the Garden his extensive and valuable collection of specimens, manuscript and illustrations, largely in color, of the genus *Capsicum*, on condition that the genus should be studied with reference to an ultimate monograph of the wild and cultivated forms. On accepting this generous gift, seeds were procured of all obtainable varieties, and about 125 named sorts have been cultivated by Mr. Duffey, and made the subject of study through the season by Mr. Dewart; and it is proposed to continue the work through 1893 and as much longer as may be necessary.

In order to obtain facilities not in its possession for the study of marine botany, and with a view to promoting such study, the Board this year authorized the Director to subscribe for the present $100 annually, for a botanical research room in the Marine Biological Laboratory at Wood's Holl, Mass., on condition that it should be actually used each year for botanical work. It is not probable that a member of the Garden staff can regularly make use of the facilities secured in this way, and when this cannot be done the Director is desirous of having the room used by some competent botanist not connected with the Garden, and invites correspondence early in each year from professors or others who may wish to study our marine flora. The only conditions imposed in such allotment of the room are that it shall be used exclusively for botanical work, and that in the publication of any results obtained the Garden shall receive credit for the facilities offered; but the Director wishes, if good reason to the contrary does not exist, to have the results of any important research published in the reports of the Garden. During the season of 1892, the room was used by Mr. M. A. Brannon, who was occupied with a study of *Grinnellia Americana*.

PLANTS FOR SALE.

The late Dr. F. Blanchard of this city, formerly of Vermont, left an herbarium of about 2,000 species of mounted plants, and about 3,000 species unmounted, the latter mostly duplicates, including many duplicate mosses. They are chiefly eastern plants, with a mixture of nortwestern ones obtained by exchange, and are for the most part first class specimens. Bids are invited, either for the whole or for a part. As a nucleus of, or an addition to a College collection they will be especially valuable. For further information address

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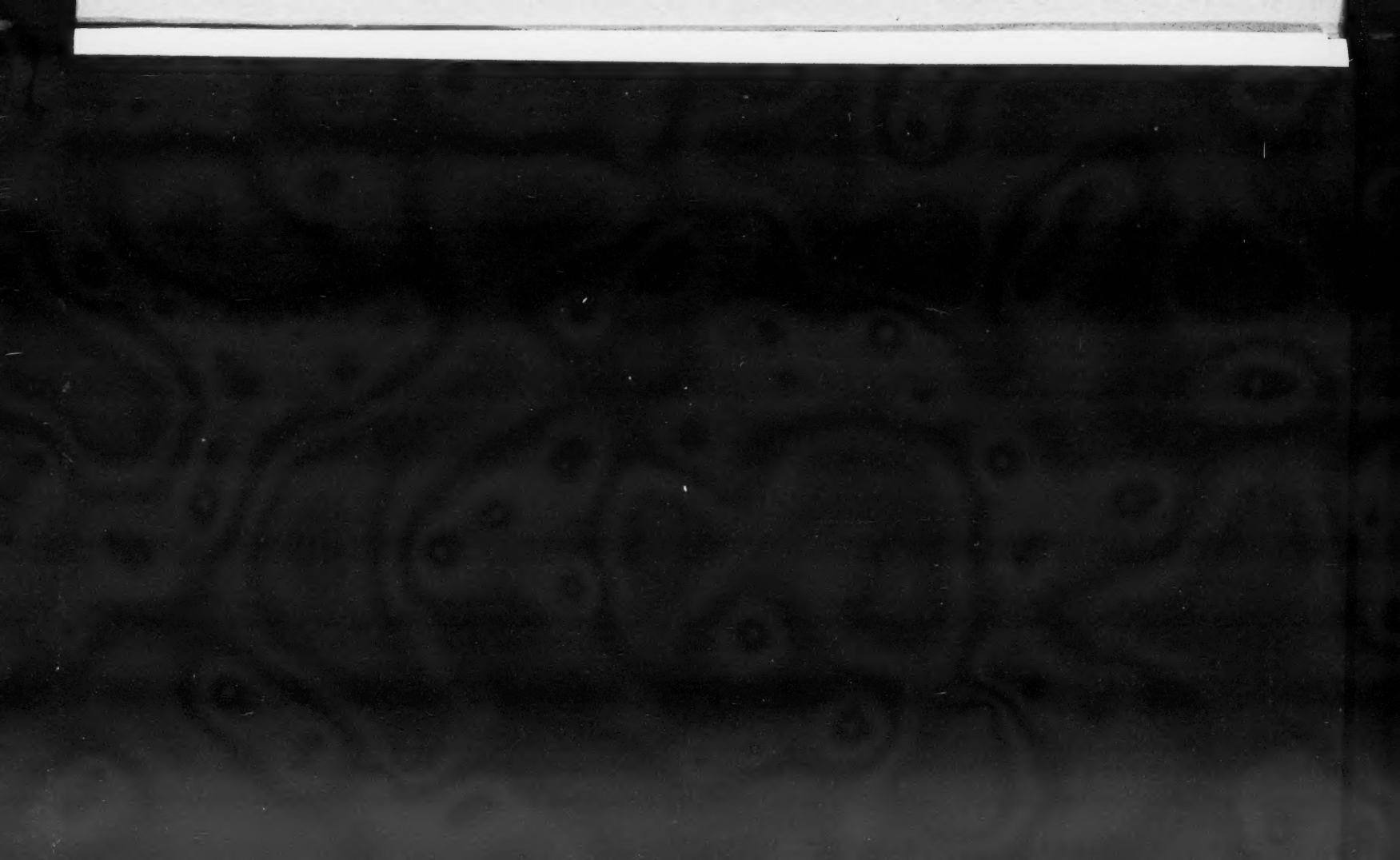

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